SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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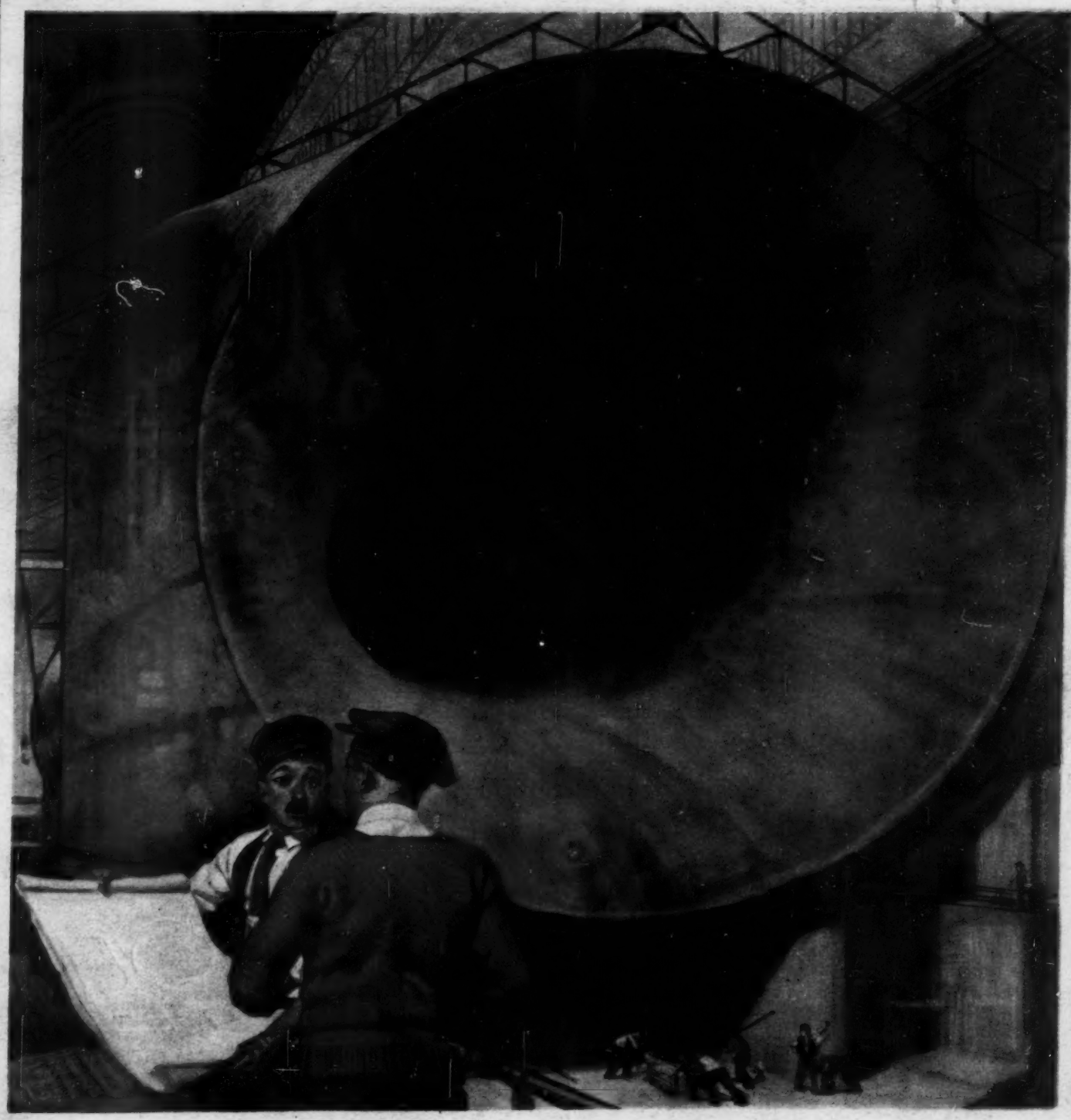

WHERE FUTURE AIRCRAFT ARE TESTED: INTAKE END OF HUGE WIND TUNNEL.—[See page 88.]

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FEDERAL has spent hundreds of thousands of dollars on new design. ~Federal has prepared for the future needs of transportation by completely modernizing its entire line of sixteen motor truck models. That's why Federal is now out in front of competition ~and why Federals are establishing a new sales record.

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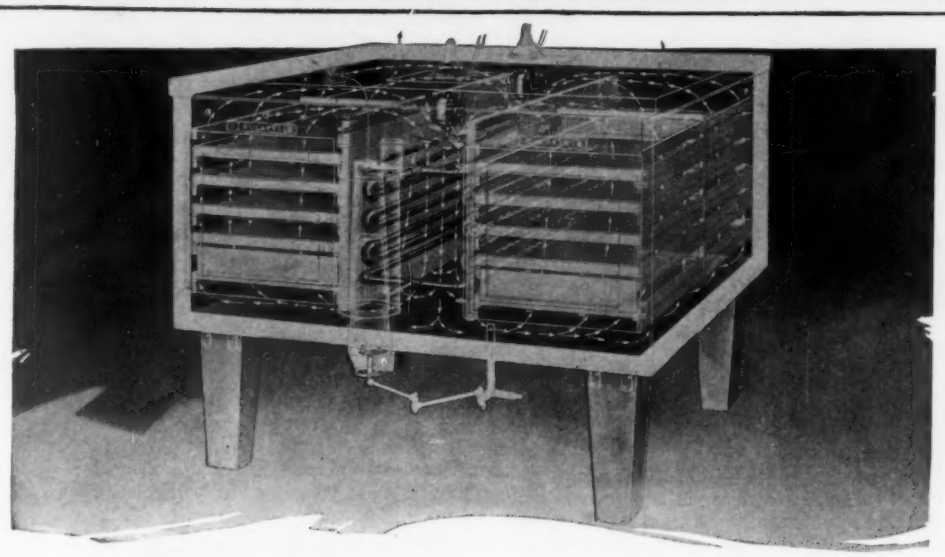

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It is a case of machine methods against hand methods; it means modernizing instead of clinging to the prohibitive handling costs of years ago. And it is requiring engineering, mechanical and commercial skill to successfully meet the conditions.

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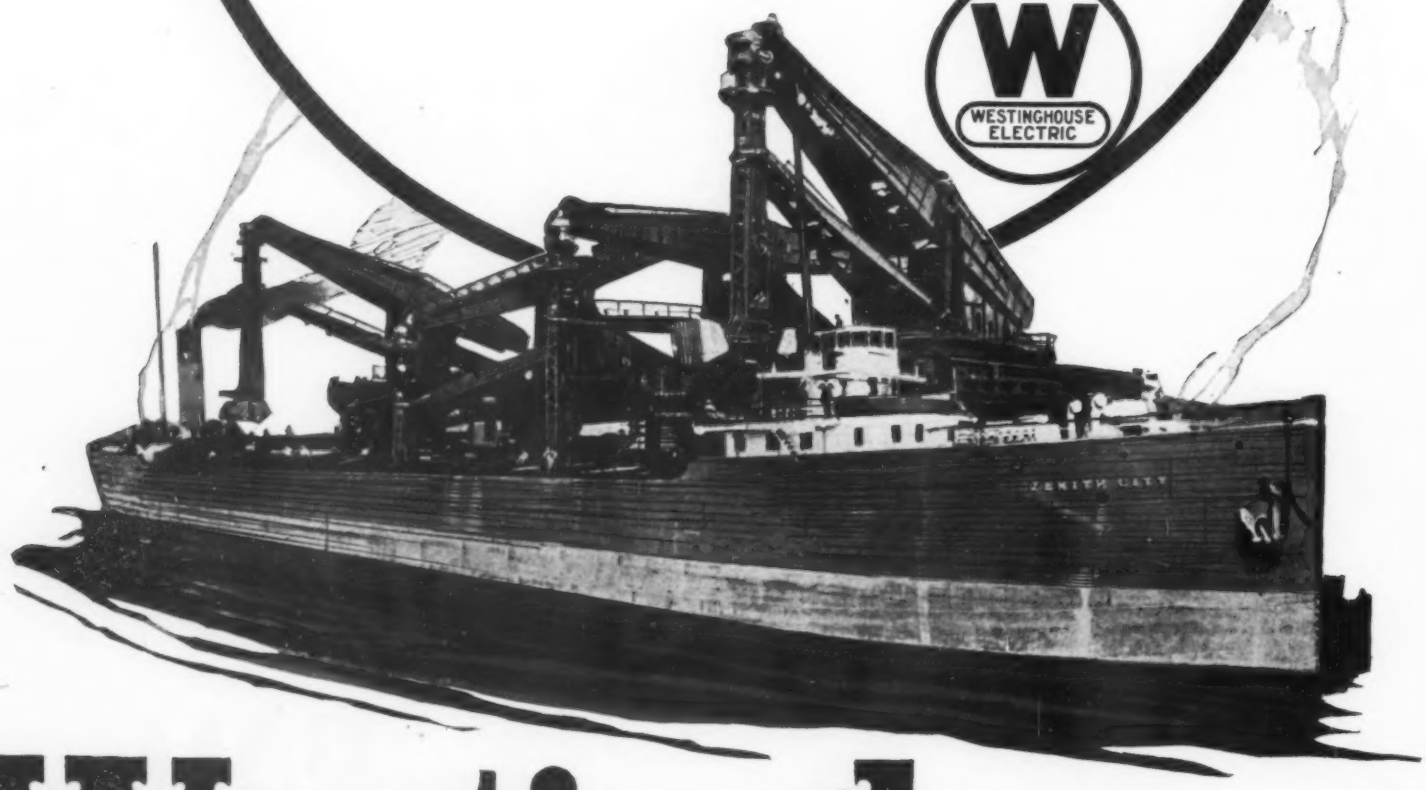

Westinghouse

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With the Editors

ONE of the most pleasing testimonials which we have ever received comes from a member of the National Committee of the Y. M. C. A. of China. "Let me express again to you," he writes, "my appreciation of the great service which you have rendered through all these years, in the interest of popular scientific education. I find the SCIENTIFIC AMERICAN wherever I go on my many journeys in China, and everywhere it is of great interest to Chinese students who understand English, and to many who don't. Personally it has meant much to me from boyhood and through these more than twenty years of popular scientific lecture work in China; and many an idea and item from its pages we have carried to the people here in spoken lecture form." All of which is just one more indication of the attention paid the SCIENTIFIC AMERICAN, and the influence it carries, all over the world. As the Briton usually says to explain his persistent reading of our pages: "You know, we have nothing quite like it here."

FOR next month our informal psychic investigation moves back to America. Shortly after their joint return to New York, Sir Arthur Conan Doyle found it possible to arrange for Mr. Bird several seances in our own Middle West. These sittings were not test ones, any more than those which Mr. Bird had abroad—they were in fact but an American supplement to his European tour, part of it rather than of our formal investigation here. In the September issue he tells of a sitting thus held with Miss Ada M. Besinnet of Toledo, regarded by spiritists as America's foremost medium; and already known by name to our readers of as far back as September and December, 1922. As usual, Mr. Bird tells what happened, without hazarding any opinion as to causes; and we are sure that every reader will agree that plenty happened to make a fascinating story.

INCIDENTALLY, we have felt rather keenly the limitation of space in connection with Mr. Bird's reports. When eight and ten thousand words of rough notes made the morning after a seance, or even the same night before retiring, while the subject was still fresh in mind—when these are boiled down to four thousand words or so, something has to be left out. So keen is the interest in this series, so many the letters of comment, so voluminous and so interesting the suggestions from readers as to how certain things might have been done and the queries as to whether this, that or the other possibility was guarded against, that we have decided to get Mr. Bird to put these informal seances into a book, from which it will not be necessary to omit anything at all that he considers worth putting in. This volume will appear during the fall, at a date and under a title that will be duly announced later.

WE dislike to promise stories for any definite issue, because whenever we do, some evil fate pursues us and crowds them out. Once or twice, indeed, the evil fate has pursued the prospective contributor, with such effect that we *never* got the story. But we have a lot of interesting features which we can at least promise for early issues. The superpower project, to which the technical world keeps returning, and which comes closer to realization with every such return, is up for attention once more. In connection with this story we shall have a handsome drawing of a typical large modern powerhouse, showing all the features that contribute to making the wheels go 'round and the "juice" flow out over the transmission lines. This drawing will go a long way toward giving our readers a better understanding of why it is so economical to manufacture power in the largest possible units.

THEN there is a remarkable new development in the rubber field, which promises to carry us as far ahead of the cord tire as the cord is ahead of the fabric shoe, and to do even more than this for the rubber industry as a whole. One of our special writers will cover this. Not unrelated is the report, which we shall soon have, of a long series of impact tests, aimed at giving us a better idea of what happens when the tire hits the road. Mr. E. D. Smith will continue his remarkable series of stories showing how the shady side of the community does it, his next contribution being on the crooked gambler who plays the cards, the wheel, or what-not, with an artificially big percentage in his favor, or with an even more immediate advantage than that. Mr. L. Lodian will favor us with another of his interesting tales of the curious things that the foreigner in our midst eats, and that we can buy and sample if we will but explore the little stores of our foreign quarters.

PERHAPS a word about this contributor will not be amiss. Born in Connecticut, he has, to use his own language, "toured from Manhattan to Mongolia; from Italy to India; from Iberia to Siberia; from Mexico to Manchuria; from Hibernia to Hawaii; from Switzerland to Ceylon and Singapore; from the Pacific overland to Poland and Paris; from New Zealand to Nippon; from the Pyrenees to the Plata; from the Andes to the Alps"—and we expect that we, rather than he, are responsible for the stopping at this point of his alliterative wanderings. He has traveled close to the ground and close to the people. He gets extreme pleasure, nowadays, in sallying forth from his metropolitan dwelling place, and exploring the marts of New York's exotic colonies, in search of the things that he has learned to eat five thousand miles away. When he has collected a sufficiency of samples, he brings them in and has our staff photographer pose them, and then goes home and prepares a manuscript describing them. Sometimes we wish we could be as enthusiastic about their odors as Mr. Lodian is about their flavors—but that is doubtless too much to ask.

THE electrical statistics upon which we based the graphic statement of page 371, in our June issue, were borrowed from the *Electrical World*, which got them together at no little cost in time and real money. Our indebtedness to this contemporary should have been acknowledged and our failure to give this acknowledgment was due to oversight, which we now make good.

AND here we are, at the bottom of the second column, and no space left to puff out our chest and brag a little about the current issue. As usual, we feel that it is the best yet, and we hope all the rest of you will feel just the same way about it.

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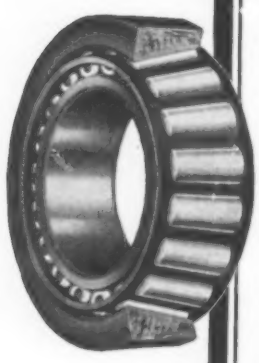
Another 250,000 "Miler"



After delivering more than 75,000 miles of service to the city of Auburn, New York, this Model "D" 1911 Franklin, illustrated below, furnished Arthur Maddocks more than 175,000 miles of service without replacement of a single Timken Bearing. A total of 250,000 miles.

120,000 miles of these quarter million miles of service were delivered in and around the mountains of Colorado.

On the 28th day of April, 1923, Mr. Maddocks furnished the following affidavit made in Denver:

"During all the time I have had the car, which is from April 1, 1913 to date, the Timken Bearings were not replaced until April 22, 1923; and the Timken Bearings delivered to a representative of the Timken Roller Bearing Service and Sales Company are the same identical Timken Bearings that were in the car on the date purchased by me, and I have every reason to believe are the original bearings put in the car. From the present condition of the bearings in question, I believe they would easily last the life of the automobile, which is at this time in first class shape and which, during the next thirty days, will be converted into a service car to be used for towing."

Twelve years of service showing more than 250,000 miles without one single Timken replacement.

The Timken Roller Bearing Co
CANTON, OHIO

TIMKEN
Tapered
ROLLER BEARINGS

Timken Tapered Roller Bearings in this 1911 Franklin have delivered over a quarter million miles of service without replacement.

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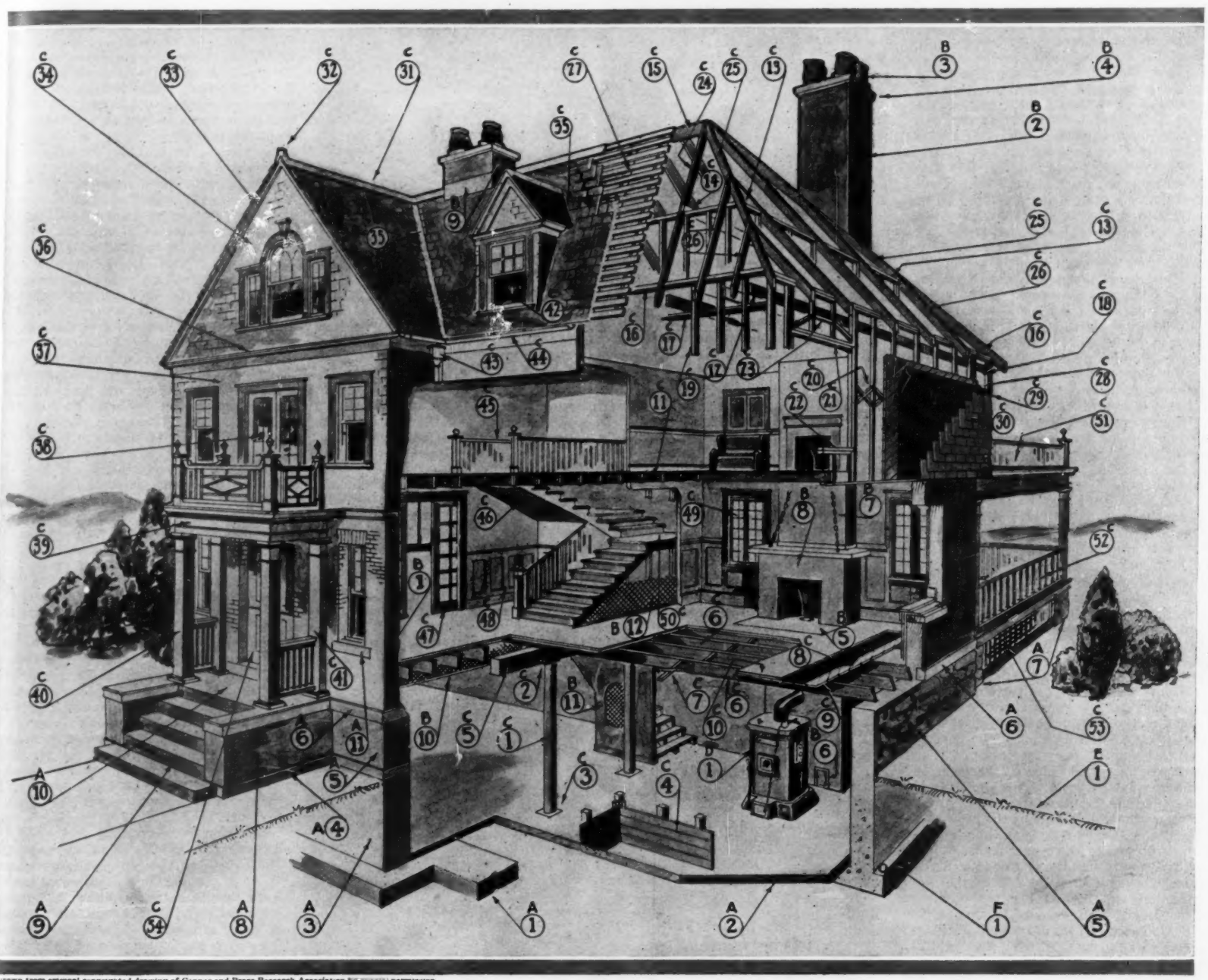
SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, AUGUST, 1923



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STONE MASON'S WORK

A— 1—Footings
2—Cellar Floor
3—Foundation Wall
4—Ground Course
5—Underpinning
6—Water Table
7—Piers
8—Buttress
9—Steps
10—Platform
11—Outside Sill

BRICK WORK AND PLASTERING

B— 1—First Story Wall
2—Chimney
3—Chimney Pots
4—Chimney Cap
5—Hearth
6—Cleanout Door
7—Supporting Chains for Mantel
8—Fireplace
9—Chimney Flashings
10—Metal Lath and Plaster Ceiling
11—Metal Lath and Plaster Partition
12—Metal Lath

CARPENTER WORK

C— 1—Iron Columns
2—Column Cap
3—Column Base
4—Coal Bin
5—Girder
6—First Floor Beams
7—Double Row Herring Bone Cross Bridging
8—Flooring Paper
9—Under (or Rough) Floor
10—Top (or Finish) Floor
11—Second Floor Beams
12—Ceiling Beams (or Attic Floor Beams)
13—Purlin
14—Collar Beams
15—Ridge Rafter
16—Plate
17—Ledger Board
18—Corner Post
19—Studding
20—Bridging
21—Rough Head
22—Rough Sill
23—Truss over opening
24—Rafter
25—Hip Rafter
26—Jack Rafters
27—Shingle Lath
28—Diagonal Sheathing
29—Sheathing Paper
30—Shingle
31—Ridge Board
32—Finial
33—Rake Cornice
34—Gable End
35—Valley
36—Eaves Cornice
37—Second Story Wall
38—French Window
39—Porch Cornice
40—Porch Column
41—Pilaster
42—Dormer Window
43—Leader Head and Leader (or Downspout)
44—Gutter
45—Balustrade
46—Stair Soffit
47—Sliding Doors
48—Wainscoting
49—Casement Window
50—Platform
51—Deck Roof (Balcony)
52—Veranda Balustrade
53—Lattice
54—Dutch Door

D—1—Boiler

E—1—Grade

F—1—Drain

Features of a properly constructed brick and frame residence, with the commonly used terms **(see page 80)**

Invention and the "Grifter"

Gathering in the Foolish Dimes and the Heedless Dollars at the Summer Amusement Parks

By Edward H. Smith

THE other Sunday at Coney Island some of us witnessed a sad example of the justly famed pitiful spectacle. A very brilliantly attired young man and his Paradisian sweetheart were plumb-bobbing. That is to say, they were standing before the booth of a concessionaire in tinsel dolls and perilous candy, swinging a bowling ball, suspended from the roof of the little kiosk by a chain, in a vain effort to knock down two fat ten pins which stood on the counter in what seemed to be the easiest range of the pendulous ball.

"The thing's as easy as pie—as soft as syrup!" cried the barker insistently.

The bravely dressed young man paid his dime, pulled back the ball and let it go. Surely it would fly back in the direct projection of the pendulum and knock down the two pins, thereby winning the doll or the candy. But it didn't. It swung out, turned and flew back in ellipse, just wide enough to miss both pins.

"Pretty close, friend; pretty close that time," sang the leatherlung. "Better try it again. See me do it! Just swing the ball right past this right pin here, like this, and—bingo! Down they go, every time. It's all a matter of skill."

The concessionaire or grifter, to give him his native name, had indeed let the ball go just past the shoulder of the pin on the right and again it had travelled an ellipse, but so narrow that it touched the left pin as it swung back and sent both of them toppling down.

"Try again, friend!" barked the impresario blithely, setting up the pins with a meticulous care that escaped his customer's attention.

The young man did try and failed. He tried again, growing redder and angrier as he saw the circling ball swish harmlessly past the pins once more.

His bedizened young lady was full of enthusiasm and excitement.

"Let me do it; let me!" she urged, and the grifter gallantly indicated to his sputtering customer that this was the proper maneuver.

She tripped on her spindle heeled, carmine shoes and took hold of the heavy ball. After a good deal of giggling and simpering she aimed her shot. The ellipse was almost a circle.

"No, no, no, Miss!" complained the grifter in earnest imitation of torture. "You mustn't swing it wide. You must cut just pahst the shouldah of the pin heah. Let me help you."

None but a practiced eye would have noticed him pick up the right pin, give it a half turn in his hand and then set it down again very carefully on the spot. Guiding the young woman's shot he let her send the ball flying past the pin by a hair's breadth. It swung away, stopped and swung almost directly back in the true pendular course. Straight between the two pins it plunged and down they went to the amusement of the crowd, the intense delight of the young thing and the black disgust of the young man.

Needless to say, the grifter immediately handed over a tinselled doll of the girl's selection and invited her to try again. She looked for encouragement to the young man and then did risk half a dozen more shots. But now, alas, she could not win. Her escort, still angry over his own failure and discomfited by her single success, took the ball and began to shoot again. He missed thrice and went away fuming, having paid about two dollars for a doll worth forty cents.

The call of the blithe entrepreneur of summer amusement followed him down the walk:

"Step right up, ladies and gentlemen. All a matter of skill, friends. All skill. Just a game of skill!"

But was it? And when the millions rush to the summer parks, the sea shore, the picnics, the street carnivals and wherever grifters and their alluring games are appearing this summer, will it be a mere lack of skill that will send some millions of good money into the pockets of these sad rascals? It wasn't in the case of the man with his ball and ten pins. That right pin had been carefully slanted off on the bottom, so that when he set it up for the trade it leaned away from its fellow perhaps half an inch at the top. That was sufficient to send the ball into an ellipse wide enough to miss invariably. But when he wanted some one to win, in order to encourage further play, he merely turned the pin half around so that it now leaned a full inch nearer its mate. Now the ball sent just past the in-leaning pin came almost directly back and winning was unavoidable.

A trick of this sort is called a gimmick or gouge—and that term is the Aladdin's ring that gives us sesame into the land of summer folly, of grifters, concessions, games, rides, hot dogs and ballyhoo.

One seldom stops to think of it, but a very large company of skilful inventors is constantly busy devising for the summer parks and street fairs. Many of these men are geniuses of no common order. The chute-the-chutes, the figure 8, the great scenic railways, the various gravity rides, the cyclorama, the airplane machines, the mechanism of the whirling houses, the witching waves and a hundred other "rides," from the humble carousel or merry-go-round to the most complicated modern thriller, all are the fruit of real inventive power and some contain prodigious ingenuity. Such inventors as S. F. Jackman, originator of the gravity rides; W. F. Mangels, of carousel fame; H. E. Riehl, of the whip and other devices; Thompson & Dundy, who developed Luna Park; and the Chesters, inventors of the balloon race games—these men and others like them were dowered with imagination and the power of originating and applying ideas. Riehl it was, by the way, who built Luna Park for Thompson & Dundy. Beginning with the Chicago World's Fair in 1893, when the first of these big pleasure machines appeared in the shape of the Ferris Wheel and the Chute the Chutes, and coming down to date, such inventors have set up their strange machines all over the country, in parks and grounds dedicated to the kind of joy these inventors made popular.

Typical balloon blowing game. The rubber balloon here is in the throat of a frog; it expands as the customer plies a lever, and the winning frog is the one that croaks first. But—the game keeper usually has mechanical control that enables him to make any given frog win

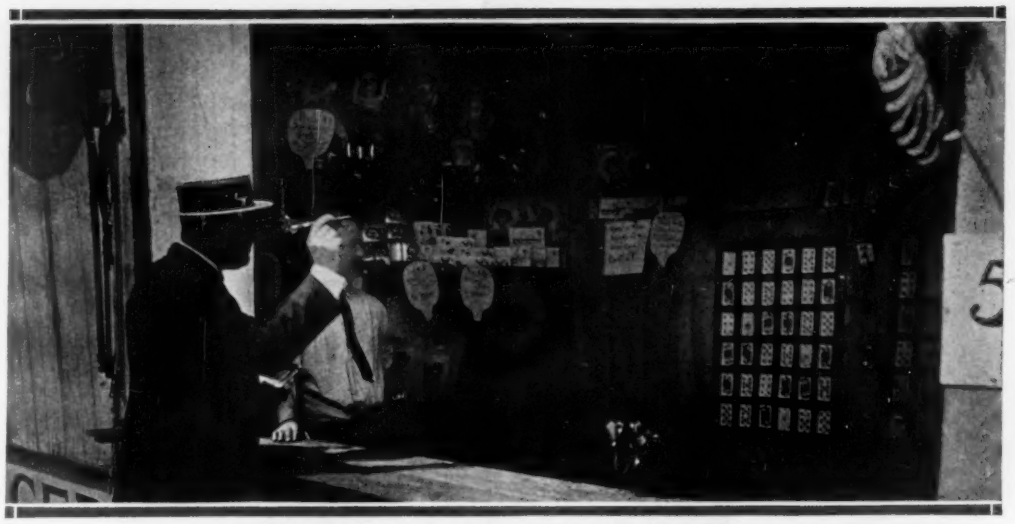
It is not of such men, or of their legitimate, high-grade amusements that I speak. But there is another, stranger and more interesting inventive genius whose dark and devious devising are part of that form of hilarious madness which comes with hot days and escapades in the parks. These men, for the most part, belong to the half-world of showland. They are the workers, grifters, showkeepers or, to be polite, concessionaires and to a very large extent they still devise their own games or adapt them from older rackets. But not so extensively as of old is the grifter his own inventor. Today there are numbers of manufacturers who cater to the summer amusement or carnival trade and they frankly manufacture all the games and devices known to this romantic world. They make them "square" or "strong," as the customer desires. "Square joint" is the grifter's vernacular for a booth where the customer gets fair play; "strong joint" the opposite. These manufacturers keep numbers of inventors at work, year in and year out, making new tricks for the old trade, for the public is ever finding out the secret of some game or coming to suspect it. Therefore, it is necessary to keep men busy varying or innovating.

Most of my readers certainly will have wondered on many a colorful day in past summers, why they could not win at some of these park concessions while the man next to them had consecutively good luck or why they lost at games of skill while some frail girl stepped up and took the prizes they had been aiming at. To understand these phenomena, it is necessary to see how the summer park grifter or faker works. In the older day the grifter always worked with an assistant or shillaber and he still does this in many instances. The shillaber both encourages "suckers" to play by word of mouth and lures them into the trap by posing as an outsider and winning consecutively. Again, many forms of amusement games are so controlled or gimmicked that the grifter, without any need of a shillaber, can let win whom he likes. An occasional winner is the best advertisement and the wily grifter usually chooses a woman as the recipient of his beneficence. So——

If you happen to be playing a game without success and some man steps up, plays successfully each time and walks off with a half dozen prizes, you may be sure he is a shillaber, who will return in good time with the goods. Often a local simpleton is hired to play this part, from

Plum bobbing; an officer inspecting the outfit to see whether it is really a game of skill as represented. The object is to drop both pins with one swing of the ball

which fact comes the very old notion that hunchbacks and halfwits are lucky. They have been carried about by the mountebanks of many centuries and always allowed to win, so that the gulled crowd might be tempted to play and lose its cash. On the other hand, if the woman beside you suddenly wins with her first or second play and dashes off with some flashy prize, you may be sure the grifter has thrown the game her way, both to encourage play among the onlookers and to send her wandering about the park with her eye-filling award, thereby advertising the grifter's game.



Poker with darts—try to get four aces if you can

Perhaps you have yourself stepped up to one of these games where several were playing, and won substantially at the first venture. If you will note carefully you will discover that this doesn't happen unless there is a crowd behind you. Your good fortune is the lure by which the others are coaxed on to ill.

But perhaps the simplest way to make the whole business clear is to take up a few of the representative summer park and carnival games and explain how they are gimmicked. Let us begin with the old and ever popular hoopla. This is the generic term for all forms of games where the aim is to throw a ring or hoop over an object to be won or a base on which this object rests to which it may be attached. The old cane rack is a good example. The oldest and crudest gimmick used on the cane or umbrella rack was to have the rings a trifle too small to go over the heads of any but the tawdriest and cheapest articles. However, the grifter always had in hand a few rings which were larger, but not perceptibly so, seen with the naked eye at a little distance. When the crowd became restive at repeated losses or poor winnings, the shillaber, now commonly called shill, stepped up and was, of course, given some of the larger rings. He immediately won the finest cane or umbrella in the rack, laughed raucously at the mock-discomfited grifter and strolled away with his prize. The crowd, of course, surged forward to take advantage of a "turn in the luck." But the gentleman behind the counter wasn't passing out any larger rings just then.

Some hoopla games belong to the order known as "flash and slum joints." In the language of the valiant summer showman "flash" means the big showy prizes offered at various booths. "Slum," on the other hand refers to the worthless small wares. Thus in the Japanese rollball game to be seen along every boardwalk in the land, the big showy pieces of Satsuma, the expensive sets and large vases are "the flash." The little match trays and ash receivers are the slum. In this game as in all others, no one wins the "flash" without paying from three to fifty times its value. However, in these roll-ball games the big pieces can be won if one has patience and money enough to stick to it.

In the "flash and slum" hoopla booths, on the other hand, the big prizes are never won by any but the shillabers. Watches are much used in these places and the cleverest grifters use fine American movements in solid gold or even platinum cases, watches worth up to two hundred dollars. But on the rack with one or two of these fine timepieces are many cheap watches, brummagem stickpins and the like. This game is gimmicked in one of two ways. Either the base under the desirable watch is a little too large for any of the rings to encircle or there are only a few rings large enough to do the trick. In the former case nothing but the slum is won; in the latter only a shillaber is allowed rings large enough to do the trick. "You pays yer money and you takes yer medicine."

There is always about all carnivals, parks and street fairs the kind of man known to the inner circles as a half-wise boob, one who can most easily be duped because he has that little knowledge that is so dangerous. For the humiliation of this kind of man, the grifter has various mechanisms containing a double gimmick. The "wisenheimer" is acquainted with the first but not the second.

Some years ago I was standing in a Chicago amusement park when a young man of the know-it-all character strolled up to a booth where a well known grifter was conducting a little trick pool game. The game keeper tried to interest this youth in his sport but met with the swaggering answer:

"Wotcha try'n ta do? Kid me? I'm wise, bo!"

"All right, son," said the grifter and immediately pulled out a curiously designed knife. He opened the blade and began carving a bit of wood.

The egotist's eyes followed the knife. In a moment he had made some comment about it.

"Betcha a quarter you can't close it," said the grifter instantly.

The young man's breast swelled with injured dignity.

"The ——— I can't," he snapped.

The bet was made and the knife handed over. Try as he would he could not close down the blade. He could not budge it from its seat without destroying it.

The grifter laughed loudly, pocketed the wise young man's money and benignantly showed his new friend the gimmick, an obvious enough little catch which kept the blade from being closed down. The sucker was delighted, tried the catch three or four times until he felt sure he understood it and then offered to buy the knife. The grifter, of course, refused to sell.

At this moment a stranger came wandering along and stopped to gape at the pool game like any countryman. The sucker, who still had the knife in his hand, as per arrangement, immediately attracted the intruder's attention and offered to bet he couldn't close it. Again a twenty-five cent wager was posted and the stranger lost. The gimmick was shown him and he, too, studied the thing carefully. Suddenly he said to the wise young man, using a rustic speech:

"Aw, this is easy. I bet I kin close it an' you can't open it."

The wise young man, of course, received such a proposition with derision.

"How much'll you bet?" he demanded.

"Fifty dollars."

The grifter, seeing from the wisenheimer's attitude that he didn't have that much, nudged him and whisperingly inquired how much he was short.

"I only got forty," said the dupe.

"Bet him," urged the grifter under his voice, "I'll take the other ten."

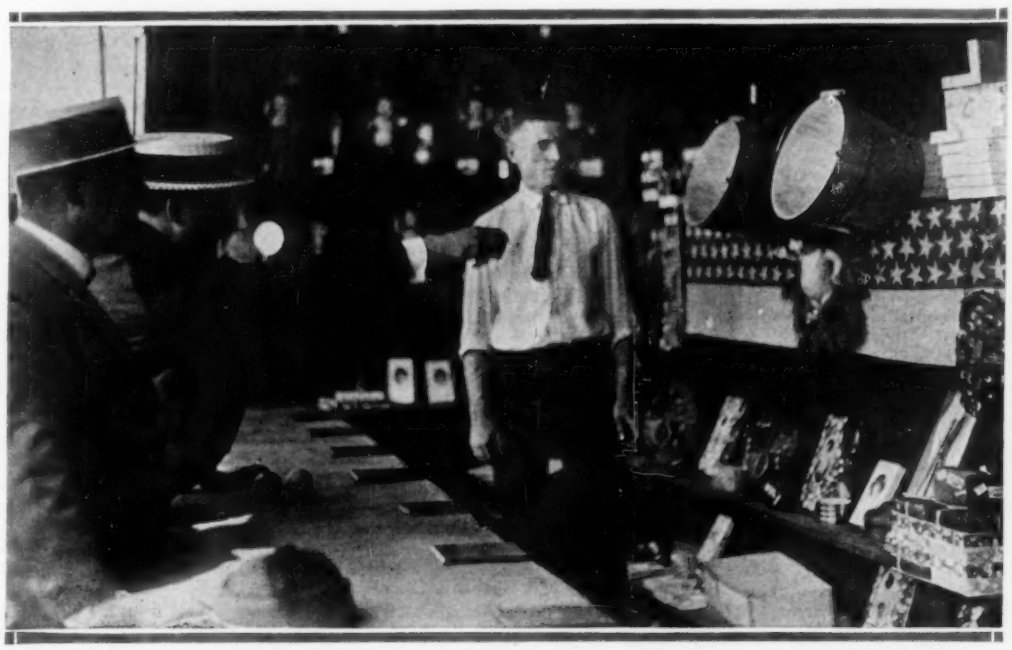
So the bet was made, the newcomer closed the knife, the grifter held the stake and the clever young dupe tried to open the blade. He tried till he was blue in the face and couldn't stir it. Then the grifter regretfully paid the bet to the stranger, who went his way rejoicing.

"Darn it," said the grifter, when the other man had gone. "That guy knew more'n I did. I didn't think there was a double gimmick on that knife."

The stranger, needless to say, had been the grifter's shillaber.

Such ingenious little instruments of fraud are being invented and manufactured constantly, and discarded in favor of newer ones as they become too widely known.

For many years, as you have walked into parks and street fairs, your eye has been caught by the man with the series of little tin cans, buckets or tubs or the triangle of little wooden barrels. The trick is to make three balls, tossed into these receptacles at short range, stay there. All of us have tried it again and again. It looks extravagantly simple, but the balls always bounce out again. Let one toss them ever so gently, out they pop and the prize is lost. But the fellow next to us makes them stick. How come?



A recent adaptation of Huckery Buck. The trick is to make the exceedingly springy tennis balls stay in the bucket. This time there is no cheat—except that it is just naturally so hard to do that you more than pay for any prize you win

This game is called Huckery Buck or Huckely Buck, depending on whether one talks to an Eastern or Western grifter, and it is managed in a hundred fashions. It is one of the classics of parkland. Of course, it is gimmicked. Last summer, at one of the principal parks, I saw a mellow old grifter, a man who had come through all the imaginable splendors and vicissitudes of life with a faint sad smile, playing live chickens or ducks against the dimes of the innocents. No one won till I stepped up under the arm of a famous old outdoor gymnast. The grifter recognized us instantly and invited us to play. My friend did so at once and soon won four ducks.

"Keep 'em for me till I come by, will you?" he asked.

"Surest thing, old man," said the grifter without the

(*Continued on page 135*)

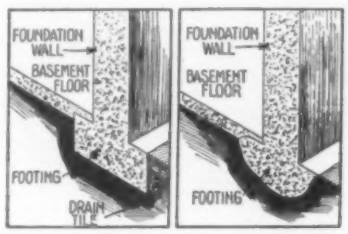
Camouflage and Carpentry

How the Housing Shortage Has Played Into the Open Hand of the Jerry-Builder

By A. G. Ingalls

DURING the past spring there has been such a boom in housebuilding as the American nation has never known. The war brought in its wake a shortage of 1,000,000 dwellings, and the effort to catch up with the consequent demand for homes has brought about a peculiar and unhealthy situation in the house-building industry. Good houses are being built—and bad. It is of the latter class and how to avoid them that this article has mostly to do.

Thousands of houses are being put up by speculative builders, a large portion of whom are doing good, honest work. But the remainder are being built hurriedly, carelessly and cheaply. In some cases the builder, after he has received his payment, does not care how shabby a house will get to look. The worst feature of it is that, to the eye of the average person who is not familiar with the building industry, the products of the good and of the bad builders may not appear to differ in quality, to any marked degree, and the would-be purchaser has the greatest difficulty in unshuffling the bad from the good. For by the very nature of a house it is unnecessary purposely to camouflage bad work. The walls, when completed, conceal it.



Foundation walls are the starting point in good construction or bad. The left-hand sketch shows good construction, with solid, large, square footing. The right-hand sketch shows poor construction, with insufficient and wedge-shaped footing which is bound to sink under the building's weight

A study in foundations

Thus it frequently happens that the home-hunter falls to the wiles of the real estate salesman who, in painting an entrancing picture of the joys and advantages of owning one's own home, knows only too well that his depiction meets with its long-since-established counterpart in the mind of the prospective purchaser—and his wife. The pretty little house is bought on the plan of "a little cash and what you now pay in rent," but because it is not properly built in the beginning, long before the final payment has been made it will have become a shabby, sagging structure with little resale value.

Admittedly, it is very difficult for the average person to ascertain whether the house the speculative builder has erected and is trying to sell to him after completion, is sound, or whether it is "jerry-built." Buying a house under such circumstances is, in part, at least, a gamble. It is like swapping jack-knives "unsight and unseen," a grab-bag affair in which the most essential parts of the house—the inner structure—are pretty well concealed by the finish. With his knowledge of house-building the trained architect, the disinterested housebuilder, or even a good carpenter can penetrate beneath the camouflage. But to the person who has not been familiar with the building industry, and that quite recently, the purchase of a house is fraught with innumerable pitfalls because there are a thousand and one details of construction principles that are seldom apparent, especially under the intriguing glamor of new paint, bright varnish and white tile.

But the man who is already familiar with the game will refuse to be thus intrigued. Nor will his eye so long rest on the fact of an attractive sunporch, a warmth-inviting fireplace, hardwood floors and a modern kitchen, as on the real structure of the house. He sees not only the finished product but the method of making that product. His mind runs to stresses and his eye hunts for strains. When he looks over his prospective dwelling, he has in his mind some such picture of the elements of a house as our artist presents on page 77 of this issue. He knows what to look for, and where to look for it.

Such a man, in company with the prospective home owner, will soon look a house over, and if it happens to be poorly built, he will be able to paint a word picture of what it will look like in eight or ten years when the walls have settled, with doors and windows continually sticking, the plaster is cracked and the roof has become swaybacked. The enticing newness will then have vanished, but the repair bills will have mounted higher and higher. Keeping up the periodical payments on such a house will have become a matter of "paying for dead horses."

The salesman who is interested in disposing of what he knows to be a jerry-built house usually devotes his best efforts to gaining the approval of the wife of the prospective buyer and he is only too glad to have her come with her husband to look it over. He does not do this so much because he thinks she will be a poorer judge of the construction details, but because he knows she is the more apt of the two to succumb to its undeniable attractive features and its cleanly painted outwardness. The tiled bathroom, the little kitchen so attractive and modern, the cozy fireplace, the varnished hardwood floors, the tasty outside trim and the leader pipes of copper are apt to loom higher in the estimation of a woman than of a man. True, the tiles of the bathroom may be poorly set, so that they will soon allow water to leak down on the ceiling below; the fireplace may prove smoky because it lacks a properly designed fireshelf in its flue; the hardwood floors may be very thin and may have no sub-flooring at all, while the shining varnish may be for inspection purposes alone, peeling and wearing off before the home is a month old. The addition of a few copper leader pipes, of themselves excellent features, costs the builder comparatively little and adds very much to the "blow-of-the-eye" value in giving a mis-estimate of the real worth of the structure. The salesman knows that if he succeeds in making a strong impression on the wife, she will work continually to overcome the objections of the husband and may finally succeed in wearing them down and out.

GIVEN honest intentions we can build altogether better houses today than have ever been built. But we do not always do it. The demand for a million homes has brought the speculative builder into his own and as the price of materials and the cost of labor have gone up, the quality of materials and workmanship have gone down. Within ten years a large number of the American people are due to discover that their jerry-built homes are in process of rapid dissolution. It will be almost too late to mend. Yet those who today will give particular attention to the structural fitness of the house they are being urged to buy rather than its superficial appearance and modern equipment will feel that their insistence on knowing what they are paying good money for has amply repaid itself. What to look for in a house and how to look for it—that is the burden of Mr. Ingalls' article, and of the drawing on page 77.—THE EDITOR.

The temptation of the builder to pare down costs to the detriment of a house, begins with the foundation. The foundation wall should have a proper footing, for of itself it is not broad enough to spread the weight over enough earth to prevent settling. Only in case the wall begins on solid rock, or in the case of a light structure such as a one-story bungalow, may the footing be omitted. Otherwise, settling is practically sure to follow—and settling brings a whole train of troubles in its wake, for it distorts the house. This causes the doors and windows to stick, refusing to close, and the plaster to crack. The floors are warped out of their original geometrically perfect form and will spring and creak under the feet. Spaces will develop between the floors and baseboards, as well as between the woodwork joints. The roof may become so distorted that it will leak. Even some of the plumbing may be disrupted.

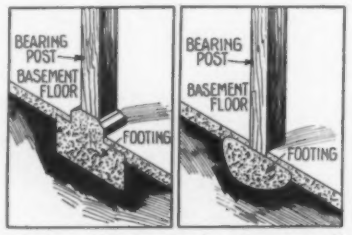
Yet in many cases, in order to save their costs, the necessary foundation-wall footings have been omitted entirely. Since the base of the wall is soon covered on the outside by a little earth judiciously pushed in by the jerry-builder, and the cellar floor is quickly grouted in, this is a rather difficult thing to make sure of.

The footing should be at least 16 inches in width and ought to be six inches in height. In most cases it is made of poured concrete and this should have enough cement in its content so that it cannot, at least, be kicked to pieces with the shoe, an act which was easily committed by the writer on the footing of a house being put up by a speculative builder of the too-greedy sort. The outline of form for the footing is generally made by cutting out a small trench of the shape desired and filling it in with the concrete mixture. But it is highly important that this trench, which is to give final shape to the footing, should be carried out flat and square to its edges. For if it is a rounded trench, the footing, instead of being flat, will have a semi-circular, almost wedge-shaped cross-section and will not be able to carry half the load that may be placed upon the perfectly flat base.

The cellar floor is generally made of concrete and should be made up of at least six inches of cinders followed by three inches of concrete and an inch top-course of cement mortar. But many houses are being built in which the cellar floor consists of no more than two inches of cinders covered by a very thin buttering of cement mortar. Since such a thin layer of concrete is certain to be broken by the rough handling of ash-cans, the cellar floor should be sounded or tested with some heavy object such as the butt end of a piece of timber. Cellar floors have been observed that could easily be picked to pieces with an umbrella.

Usually there is a girder across the cellar and its function is to support the inner ends of the joists as well as the weight of the partitions above it. These in turn carry the inner ends of the second story joists, together with the lath, plaster and other heavy details. The support of this girder is highly important. If the span is long, a pier or column should support its center; and just as important, that support must have a broad footing, not merely on top of the concrete floor, nor on a small chunk of concrete which has been poured into a shovel-hole in the earth, but on a "duck's foot" at least sixteen inches square on a flat bottom. If one end of the girder happens to come opposite the main chimney, it most certainly must not have support in the latter beneath the fireplace. Otherwise, a fire will eventually be the result.

If the cellar wall is made of hollow blocks a searching investigation of the mortar should be made with a jack-knife. In some jerry-built houses now being sold, the mortar used in the foundation walls is little better than mud and may be picked out quite easily. However, if the wall is made of monolithic concrete it will do no harm to be suspicious of a kind of "veneer" construction which has become fashionable among contractors of the sort who wish to make the most of a job financially, at the expense of good work. In this case the inside and the outside of the wall are of quite good concrete but they are only shells. Careful inspection will reveal some weak spot in this shell into which a short lever may be inserted to pry off whole slabs of the wall. But an honestly built wall of solid concrete without trash filling should withstand any battering test the interested person can bring against it with the end of a timber.



Bearing posts are of prime importance if a house is to remain true, doors are to close properly, and walls are to remain uncracked. The left-hand sketch shows how a bearing post should be supported, while the right-hand sketch shows how it should not

Good and bad cellar posts

Such a veneer wall will often be shown up by the formation of large blisters or swellings on its face directly under the point where the girder bears heavily on top of the wall. These are caused by the buckling of the veneer under the great weight of the weak wall.

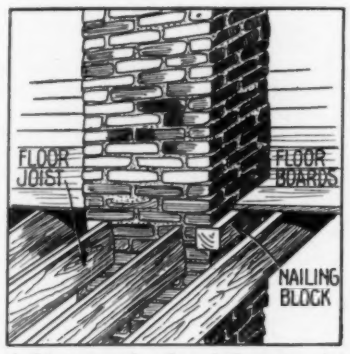
Many builders have gradually got into the habit of economizing on the strength of the floor joists, and this may often be observed in houses which are being put up to sell when finished. Those in the cellar may be examined and measured. If the span exceeds 12

feet, they should be 2 by 10 inches, not 2 by 8. The decrease in strength brought about by the use of the smaller joist is disproportionate to the respective sizes of timber. Roughly, the eight-inch joist is but two-thirds as rigid as the ten-inch size.

The joists in a solidly built house will generally be spaced 11 inches apart, from center to center, although there are places where an increase of two or three inches is allowable. But because there is so acute a shortage of houses and almost any house will sell, houses are being built and sold today in which the floor joists are spaced 18 inches apart and are of but eight-inch stuff. This makes a nonrigid floor which will soon creak and will tremble under every impact.

The cross-bridging between the joists is the series of small pieces forming crosses. These pieces do not need to be more than an inch thick, but the main thing is to see that they are provided, and that none are missing. Trifling as they look, their omission renders a floor far less rigid against localized shocks and loads. Their function is only secondarily to hold the joists in place. They are for stiffening the floor. Imagine a sudden load applied directly over a single joist. That joist springs down. But the motion is carried through the bridging pieces, sidewise and downward to the joists on either side. The stress has thus been distributed over three, not merely one, joist. But as the outside pair go down they in turn transfer the motion through their own bridging pieces to their neighbors—and so on to all the joists of the room. The omission or careless placing of a single piece breaks the chain and the floor trembles unduly.

One very common fault of the cheaply built house is caused by supporting some of the framework directly on the fireplace chimney. To this there are two objections. A fire may result; and there will be settling around the chimney. In any house the big fireplace chimney is very heavy, and no matter how good its footing it is apt to settle to some extent. Any portions of a house which are attached to it in a manner so that they are dependent on it for support, will also settle, in fact they will help cause the settling. However, many houses are being built in which this cardinal sin is being committed, for it renders construction a little less expensive and falls in with the policy of the jerry-builder to pare down the quality of little things here and there from cellar to ridgeboard, making up a total saving that feels good in the pocket. The fireplace should be a separate entity from the house, attached to it only for the purpose of keeping out the elements. These attachments are comparatively light, thus permitting the chimney to settle without pulling the framework of the house along with it.



A chimney running through the center of a house is always a great temptation to the irresponsible builder. Floor joists are only too often rested on the chimney, and nailing blocks on the chimney serve to hold the flooring. A chimney should always be free of such burdens because it has enough weight of itself to support. This point is very important

Putting the burden on the chimney

Fireplaces are always built into the speculative house because nothing so greatly adds to the "I-want-it" feeling of the prospective home owner as the presence of a hearth. But some of these houses have no fireshelf in the flue—a saving in mason work on the part of the builder made in a place where inspection is quite difficult. The purpose of the fireshelf is to control the currents of air and hot gases in such a manner that there will be a good draft. A properly constructed fireplace flue, when viewed from below, is seen to converge not only at the sides but at the rear—that is, the rear wall tips forward until the throat is but four or five inches from rear to front. This constriction, providing it is not so great that the cross-sectional area at this point is less than one-tenth the area of the main fireplace opening, does not hamper the draft, but improves it. The broad ledge formed by bringing the rear wall forward is called the fireshelf. It deflects the ever-present downdraft of cold air from the outside away from the fire and upward again.

A deep fireplace should make the buyer suspicious that the fireshelf has been omitted, the idea of the deep opening being to overcome the consequent tendency to smoke—a thing it will fail to accomplish. A deep fireplace also prevents the heat from getting out into the room where it is wanted, but a properly built throat will so perfectly control the smoke-causing downdraft that the fireplace will draw strongly without smoking when the opening is very shallow.

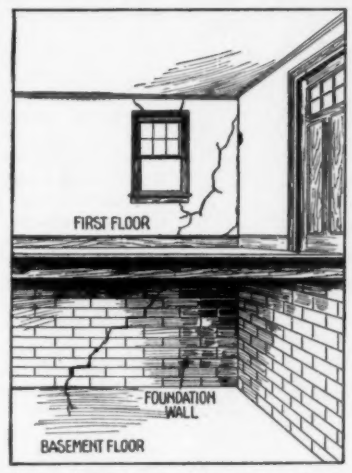
Many of the houses that are now being built have partitions which one could "throw a cat through." These are being fabricated in several ways, in all of which the intention is to cheapen the cost of construction by saving labor, as well as to provide a partition that will survive the sale of the house. All sorts of substitutes for sound partitions are being employed and in many cases their weight is being carried on but a single floorjoist. Where plaster is applied to plasterboard on such poorly supported partitions it is quite sure to crack along the outlines of the individual sections.

Some of the substitutes which are being employed to take the place of sheathing on the outside of the house are very faulty. The chief purpose of sheathing is to give rigidness against stresses in a diagonal direction. But there can be little rigidness in a diagonal direction if wooden lath applied to heavy paper are nailed against the studs and stucco is applied to the lath. Here it becomes a case of the stucco bracing the house against diagonal stresses—a thing it should not be expected to do—instead of the house holding up the stucco, as should be the case. The stucco will, however, in most cases remain uncracked until the house has been sold by the speculative builder.

Nothing will give a house as depreciated a look as a sagging or swayback roof. However, houses are now being built and sold whose roofs are bound to present a very sad appearance within a short period of years because the rafters are too light, too widely spaced, and in certain cases are not even tied together, either by the attic floor joists or by collar beams. When the weight of such a roof is exerted downward, especially under a heavy snowfall, the outer or lower ends of the rafters are pushed apart. But if they have been properly spiked to the ends of the floor joists this force cannot have any deforming effect on the roof and the roof will not sag, nor will the walls of the house be spread apart. This is another one of the structural details which a salesman will not be so apt to dwell upon as the less definite aspects of the general attractiveness and inner convenience. The builder who insists upon saving a few dollars is to blame—and he knows full well the effect of such workmanship. The carpenter also knows, but he must follow plans. But he knows who will have the say about planning and building his own home.

Since the price of lumber has so greatly increased many new materials have come into the market, but it would be shortsighted to condemn them all simply because they are different. They must be judged on their individual merits. In order to be good a house does not have to be built in the "good old way." Expanded metal laths are new—but they have made good. Walls which are built up by various processes involving the spraying, casting or plastering of mortar on to fabrics or woven wire are not intrinsically bad. But if the house settles some of these partitions are bound to crack badly for they are quite inelastic.

This brings us to the oft-heard statement that "they don't build houses as well as they used to." This is a very equivocal statement, but when it carries the feeling that good housebuilding is a lost art it is erroneous, for we can build better houses today than have ever been built. In the "good old days" timber was cheap and the lavish use of it was not so much a virtue as a result of the scarcity of sawmills to cut it into pieces of the smallest adequate size. The early builders had a way of making their houses far too strong in some places and altogether weak in others. The strength of a building cannot be wholly judged by the size of its frame timbers, but a knowledge of structural engineering is necessary in order consistently to apportion the size of the timber to the stresses. The strength, for instance, of a two-by-four scantling, provided the load is kept directly above its long axis, is surprisingly great. And a single nail in the correct place will hold more than several in the wrong place.

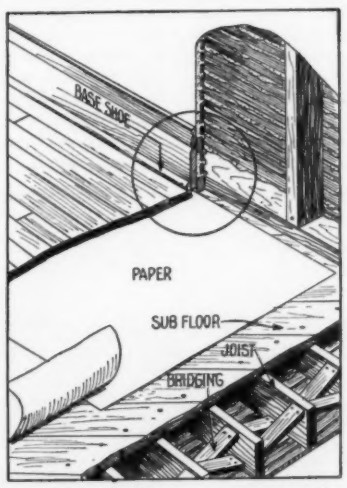


Always be suspicious of diagonal cracks in walls, no matter how new or how well built a home may appear. Cracked walls indicate settling foundations, settling or weakened or rotted bearing posts, or the use of insufficient framework and undersized lumber. Great care should be given to the examination of foundation walls

The meaning of cracked walls

The old-fashioned floor joist was about four inches by five. This gives a cross-sectional area of 20 square inches. But a joist of modern shape and having an equal cross-section would be sawed out in the form of a two-by-ten and would, owing to the greater depth of the wood in a vertical direction, have more than twice the strength of the other.

The old-time builders knew little about adequate protection against winter cold. Building paper was not used. A house with which the writer is well acquainted was built in 1856, by a builder, for his own occupancy. Yet its walls have neither sheathing nor building paper. Between the habitants and below-zero weather was only the wall paper, lath and plaster, and plain clapboarding whose joints cannot be kept tight. The difference is evident in the coal bills.



Here is what good construction means with regard to floors and inside walls. Note the heavy joists connected by bridging which makes for rigidity and distributes weight evenly. Then there is the sub-floor, laid diagonally. Next, the building paper, which keeps cold air and dust from working up through the floor from the cellar. Finally, the flooring proper. Note, too, the wall construction

Honestly-built floors and walls

A Readable Series of Monographs on the Departments of the Government

PRESIDENT TAFT said, "Never has this vast organization (the United States Government) been studied in detail as one piece of administrative mechanism . . . in such a way as to present a clear picture of what the Government is doing." To lay the basis for such a comprehensive study the Institute of Government Research has undertaken the preparation of a series of monographs giving a description of each of the fifty or more services of the Government. The Institute of Government Research is not a part of the Government in any sense, but is an association of citizens who are interested in the promotion of efficiency and economy in its operation. There has been cooperation, however, between the Institute and the Government, for the reason that the personnel of the Institute includes people whose names inspire confidence in the opinions rendered. Among its trustees are William H. Taft, Herbert Hoover, both acting wholly in their individual rather than governmental capacities, George Eastman, Arthur T. Hadley and A. Lawrence Lowell.

The monographs, each dealing with a different branch or bureau, are all prepared according to a uniform plan, are written in plain language and are readable rather than dry. They give the history of the service, its functions, its organization, the character of its plant, the laws regulating its operation, its financial condition and a complete bibliography of sources of information bearing on the particular service under discussion. "To the public," states the Institute, "these monographs will give that knowledge of the organization and operations of their Government which must be had if an enlightened public opinion is to be brought to bear upon the conduct of governmental affairs."

Monographs dealing with the Geological Survey, the Reclamation Service, the Bureau of Mines, the Alaskan Engineering Commission, the Tariff Commission, the Federal Board for Vocational Education, the Federal Trade Commission, the Steamboat-Inspection Service, the National Parks Service, the Public Health Service, the Weather Bureau, and the Employee's Compensation Commission have been prepared and may be purchased from the Johns Hopkins Press, Baltimore.

A monument to waste—the trash burner at a southern yellow-pine sawmill

The Paper of the Future

Means, Ready to Hand, for Staving Off the Impending Famine in this Essential Material

By S. G. Roberts

OUR DAILY newspapers and our printing presses generally are using up annually a vast amount of paper stock which fundamentally draws its raw material from timberlands. The public at large gives little heed to the significance of this drain—the citizenry is concerned only in getting enough reading matter to satisfy its more or less avid demand for news, information and entertainment.

Two years ago we employed in the manufacture of paper more than 6,100,000 cords of pulpwood, and the point to be kept in mind is that the rate of this consumption of the available stands of timber is steadily climbing higher and higher. Both the authorities of the United States Department of Agriculture and the officials of the American Paper and Pulp Association have studied the situation with no small measure of alarm, recognizing how many industries rely, either directly or indirectly, upon an abundance of pulpwood, wood pulp, and the finished paper made therefrom.

The American Paper and Pulp Association emphasized a short while ago that we have become increasingly dependent upon foreign forests in the last seventeen years for a big share of the wood pulp used by our paper mills, and this despite the augmented utilization of domestic wood. It seems that of the total consumption here of pulp in 1920, fully 35 per cent was imported pulpwood and wood pulp. In addition, we obtained during the same year from foreign sources 730,000 tons of newsprint valued, with other alien paper supplies of relatively small amounts, at $85,000,000.

The association declares "The cut-over forest lands of the eastern United States, under proper management, could be made to produce the needed wood. Delay in this project will pile up the eventual cost." This wide-awake organization pertinently asks: "Why not begin now?" The purpose of this article is to reveal some of the promising work that has been done in this direction and to show how an apparent waste can be turned into a gain of great economic moment.

At the present time, the manufacture of the wood pulp is, for the most part, concentrated in the New England, the Middle Atlantic, and the Great Lakes States, where formerly there were abundant local stands of spruce. Now, however, the wood for these mills generally comes from afar; and there are plants in New York State, that obtain their raw material from Canada, which have to pay around $40 a ton for the delivered pulpwood. At the point of shipping, the average price of that wood was approximately $12 a cord. Broadly stated, it requires about one and one-half cords of non-resinous logs to yield one ton of wood pulp. Manifestly, the cost of the finished product will increase as the journey from the forest to the mill is lengthened. The pulpwood consumed by our pulp manufacturers in 1920 entailed an expenditure of $116,495,720.

Down in the Southern States, where the long-leaf yellow pine flourishes, the forests are being stripped of their timber at the rate of nearly 4,000,000 acres annually. There are today more than 30,000,000 acres of these denuded tracts in the Southland; and because of the difficulties incident to removing the stumps probably not one-tenth of these quondam forests have been made fit for agriculture, even though the potential productiveness of the soil is fully recognized. Moreover, when one of these resinous pines is felled only about one-third of the tree ever reaches the market in the form of lumber; and the prevalent wasteful methods of tapping the pines for turpentine are killing yearly an appalling number of them. But why concern ourselves with the resinous pines when resinous woods are utilized to but a minor extent in the making of paper? Because long-leaf yellow pines offer the means by which to decentralize our paper-making industry and assure us an enormous quantity of raw material which can be put to use in the manufacture of wood pulp and of by-products of great value.

Of the several chemical processes for the pulping of wood, the sulfate process is the one peculiarly suited to deal successfully with resinous woods; and it is this process which bids fair to give economic importance to the big stump-dotted areas in the South which have hitherto been deemed little better than worthless. The imminence of the new era is the climax of the efforts of engineers, chemists, and business men, during the past seventy-odd years, who have striven along three main lines to garner the wealth stored in those billions of charred or weather-blackened stumps. Latterly, this subject has engaged the attention of a group of New York industrial engineers, and their achievements both in full-sized plants and in a miniature duplicate of a commercial mill have opened a sure way for future operations on an extensive scale. This is the outcome of substantially six years of research.

Before describing what Joseph H. Wallace and his associates have made practicable, it might be well to outline the paths previously pursued by inventive genius in approaching this problem of conservation. The first of these aimed to obtain tar, pitch, and charcoal from the stumps and the trash wood by subjecting them to destructive distillation, the value of these commodities being counted upon to offset in a measure the cost of clearing the land. Since pine oils have become useful in the flotation treatment of certain minerals, this utilization of forest waste has proved moderately profitable.

The next endeavor was to tap the treasure house of vegetal riches by means of the so-called "steam-and-solvent process." The procedure consists in cutting the wood into fine chips, then steaming the latter in a closed vessel under sufficient pressure to distil off the turpentine—the residual woody matter being afterwards dried and burned for fuel. This process became commercially worth while only when it was discovered that resin could be extracted in paying quantities if the by-product chips were acted upon by a suitable solvent.

The third essay sought primarily to put the fiber of the wood to service in the manufacture of pulp and paper. The resinous nature of the raw material, however, offered a serious stumbling block to this undertaking, inasmuch as the wood would not yield readily to the acid pulp methods commonly relied upon by the industry. Such was the state of the problem in 1906, when it was learned here that pulp mills in Scandinavia were getting good results with the sulfate process when handling wood containing considerable resin. Following very promising work in their laboratory, in producing chemical fiber and paper from yellow-pine waste, Mr. Wallace and his collaborators shipped a quantity of kindred raw material abroad and made a demonstrating commercial run in a Swedish mill. The outcome was highly gratifying. As an aftermath, a large mill was built in Mississippi in 1912-13; and it was possible there to turn out chemical pulp and Kraft wrapping paper at a lower cost than had ever been feasible elsewhere. Several other plants have been established in the South since, and they have uniformly disclosed the value of waste yellow-pine wood as a basic substance for the profitable manufacture of pulp and paper.

While the three foregoing methods have proved commercially successful in varying degrees, still none of them recovers a large percentage of the total wealth latent in the old stumps and in the logging waste of the region under consideration. For the most part, the various processes have been operated independently of one another and with little regard to their economic correlation. In short, taking the business as a whole, it has lacked stability.

It should be borne in mind that the woody fiber, so essential to the production of pulp for paper making, is destroyed when the wood is subjected to destructive distillation or when it is treated by the steam-and-solvent process. For industrial purposes, the cellulose of the pine is worth fully as much as all of the other substances associated with it; indeed, the superiority of this fiber in the matters of strength and pliability is especially notable. Therefore it is most desirable that the wood be handled so as to make available a maximum amount of this excellent material. And now we come to the most heartening aspect of this whole subject; the story of how research has revealed ways by which several processes can be coordinated and by which the cut-over pine lands, valued at present at about $5 an acre, can be made to give a net return of substantially $600 per acre from the cumbering stumps and wood trash—leaving the cleared areas available for farming or for other uses.

Again, Mr. Wallace and his co-workers have evolved a solution of a complex problem through the medium of laboratory facilities; and in consequence of their investigations, begun in 1916, it is today practicable to utilize every bit of the stump and logging refuse in an efficient and profitable manner. Even though stumps may be superficially charred or blackened by long exposure to the weather—having the out-

Cotton growing on southern land, formerly waste, but from which the stumps that made it worthless have now been cleared. And the stumps can be made into paper!

ward appearance of dead wood, still beneath this cloak is a wealth of unimpaired fiber and an amazing amount of resinous matter. Stumps ten, twenty, and thirty years old are, as a rule, substantially sound and capable of yielding prime wood pulp and paying quantities of so-called naval stores.

The new and coordinated system embraces the three following outstanding activities:

1. The manufacture of chemical fiber suitable for the making of Kraft wrapping paper, book paper, and test board.

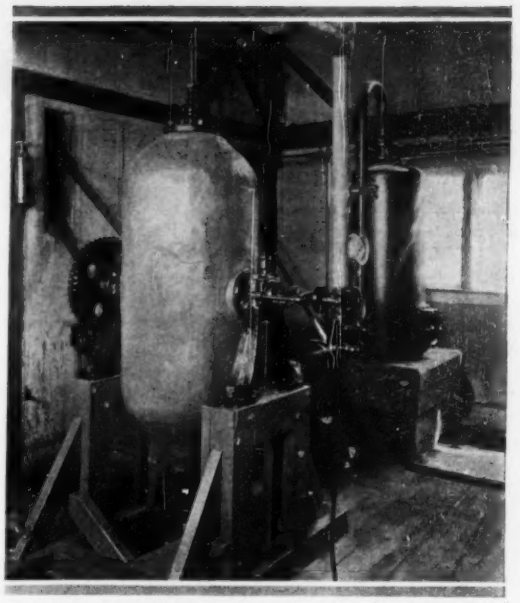
2. The by-product manufacture of such naval stores as turpentine, pine oil, and resin.

3. The destructive distillation of wood trash—unsuitable for fiber—for the purpose of producing acid, flotation oils, etc., as well as a residual fuel useful in carrying on some of the operations.

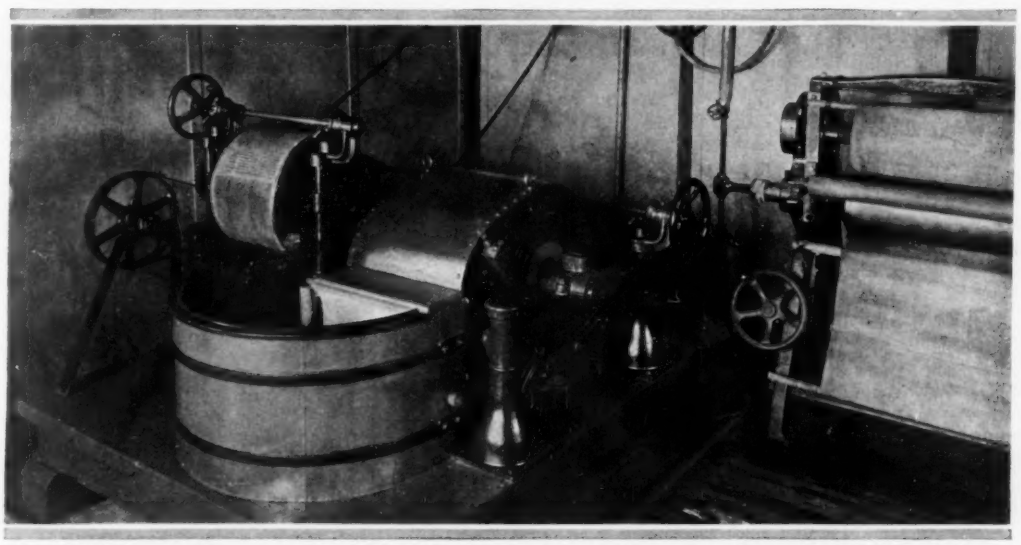
In a broad way, the intention is to divide the work between what might be termed semi-portable field plants and permanent mills conveniently located—the field plants serving as feeders to the latter. Using the processes perfected by the technicists in question, the field equipments will turn out turpentine, pine oil, resin, pyroligneous acid, and tar in addition to the main product, pulp chips of a uniform moisture, acid, and resin content. A standardized chip is something that has long been lacking and yet a factor very much to be desired in the chemical wood-pulp industry. In the absence of it, the making of pulp for paper has been attended with many uncertainties, such as the time consumed during some of the stages of preparation; the probable chemical composition of the chip; and varying physical qualities that might cover a considerable range. These uncertainties have added greatly to manufacturing costs, and all too frequently have meant the difference between profit and loss.

We are assured that no more complicated apparatus is required than ordinarily found in the run of saw mills, and that the labor need be no more skilled. The application of the method involves only the performance of work along prescribed lines; and the turpentine, oil, and resin extracted from the chips are of a superior grade. It follows, of course, that the use of a standardized material for pulp making insures a better product; and the experts also claim that it is practicable to get an increased yield. The marked effectiveness of the procedure employed in taking naval stores from the raw chips is principally due to the action of a selective solvent. The nature of this, however, has not yet been made public. Experience has proved that the modest value of the low-grade resinous material remaining in the chips after exposure to the solvent does not warrant its removal in advance of pulping. Besides, this resinous matter serves as fuel in the subsequent recovery of the chemicals utilized in pulp making.

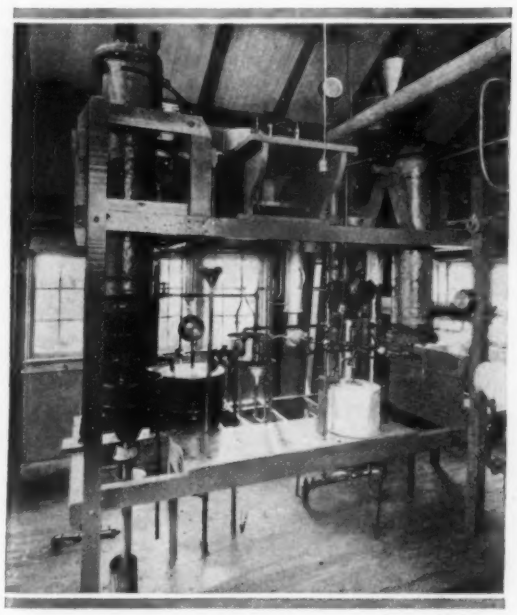
A survey of cut-over pine lands in Texas, for instance, has shown that there is commercially available per acre an average of 7½ cords of pulpwood and 4½ cords of trash wood. Taking the prices prevailing last year, the 7½ cords of pulpwood would yield 3⅛ tons of Kraft paper worth $375; from the chips, preliminary to pulping, the field plant would extract prime naval stores to the value of $147.50; and the treatment of the trash wood by destructive distillation would give turpentine, pine oil, tar oils, and pitch capable of bringing $98, making a total return of $620.50 per acre. This figure does not include the value of the fuel that must be burned to run the distillation plant, or of the solvent obtained during one stage in the operative cycle of the entire system. It is estimated that an outlay of $30 per acre would cover the charge for clearing, *i. e.*, $15 for the land and $15 for the material taken therefrom. Apropos of this whole subject of a more economical employment of waste pine wood, it should be pointed out that sawmill refuse is plentiful throughout the Southern States; and this raw stuff can be had for pulp making in well-nigh unlimited quantities at $1.50 a cord. Aside from this source of supply, however, there is enough workable material in the abandoned timber lands to keep the modern system going on a splendid scale for three or four decades to come. Further, by replanting the cleared areas with yellow-pine seedlings, a second marketable growth, fit for lumber and for pulping purposes, can be counted upon in the course of 30 years. The long-leaf pine grows fully twice as fast as the northern spruce.



The digester and diffuser employed in demonstrating, on a laboratory scale, the practicability of making paper from the yellow-pine wastes so plentiful in the southern states



The miniature beating engine, a faithful duplicate of a regular paper-mill machine, which has been employed in showing how the cellulose of yellow-pine stumps can be turned to a handsome profit



Semi-commercial extraction plant used in developing a process for the manufacture of high-grade naval stores in connection with the large-scale utilization of yellow-pine wastes

A fact not generally realized is that the sulfate fiber from yellow-pine wood waste is by no means limited to the making of wrapping, envelope, and bag paper, not to mention box and carton boards of the higher grades, but is equally applicable to the manufacture of many other lines of finer products, *e. g.*, book, magazine, stationery, writing paper, etc. It is authoritatively stated that in whatever directions chemical fiber now dominates the field because of its virtues, there sulfate fiber from our southern pine waste will, for the same reasons, eventually hold sway, while in all branches of papermaking where fiber strength may be an important consideration this newer commodity will outrank all of its competitors.

Finally, by clearing off the cut-over pine lands in the manner described, great areas will be made available for agricultural development; and where tracts have thus been turned into farms the abundant productiveness of the soil has been demonstrated conclusively. This is a matter of vital moment to millions of our citizenry.

Radiant Heat Versus a Gale

DURING the coldest days of the winter, pedestrians who passed by a certain store window in New York were almost without exception caused to jump slightly as they unexpectedly and suddenly came within the invisible shaft of radiant heat thrown out across the sidewalk by a mammoth electric bowl heater made only for advertising purposes and using about fifteen times as much energy as the common bowl heater such as is often used to heat a bathroom on a cool morning. One of the most remarkable things about this method of heating is that it is not affected by any degree of wind; the wind does not blow the heat away or to one side in the slightest degree. Moreover, the heat passes through the intervening air and glass without heating it. These characteristics set up a fine illustration of the difference between radiant heat and sensible heat, which, if exactness is required, are two separate and different things which are given the same name. Is it not true, then, that radiant heat and sensible heat are both forms of heat? Would they not both heat the hand that is brought to them? The truth is, both kinds give the same report to the human nerves. But the one, sensible heat, is the only one we have sense-organs capable of perceiving, while the other, radiant heat, gives us no report at all until it has impinged upon our skin where the ether vibrations which constitute radiant heat set up molecular vibrations which are sensed as heat. What we then perceive is not the original heat at all, but the effect of it, translated into the same molecular vibrations that occur in a piece of hot iron. A hot iron can warm the air around it, but the passage of radiant heat will not; for it is not transmitted by the air but by the ether. Like light, it finds the air no obstruction. When it strikes an opaque object, however, it stops, sets its molecules into vibration, that is, warms it, and from this it is given up to the air as sensible heat of the sort to which we are accustomed.

Since the ether is in no way influenced by the wind, the beam of radiant heat reaches out into the winter breeze, passing through the window without heating it except in a slight degree owing to the presence of impulses in the glass.

The beam of heat thrown by an ordinary automobile headlight will be very strongly felt if we step in front of it when the car is standing, whether there is a calm or a strong wind. If a radiant electric heater were placed in a room having walls of high-grade glass there would be no heating of the room. But if some opaque object were placed in line with the heat ray or beam, such as a piece of furniture, the room would soon warm up.

Our Point of View

Our First Psychic Tests

THE REPORT on our May seances got into the July issue only by our taking a form off the press after printing had commenced. The page corresponding to the present one, however, was so far advanced that editorial comment necessarily went over until now. Such comment must take several directions.

Adherents of the medium have described to us phenomena obtained in their presence which go far beyond anything done for us, and which if accurately reported would call either for genuine mediumship or for extensive confederacy. These manifestations we have not felt called upon to explain or to deny. We have no concern with what the medium has done at other times and places and under other conditions than ours. All we need say and all we can say is that there was no evidence that the phenomena produced for us were genuine, while there was every indication that they were not. Our Committee's conservative statement is due not to absence of conviction, but merely to scientific repugnance against a verdict covering more ground than the investigation had covered.

Our electrical apparatus has not been questioned, *per se;* but doubt has been expressed that its data can lead to so categorical a conclusion. Its sensitivity was such that a weight of nine pounds in the medium's chair was sufficient to keep the tell-tale lamp a-light. This should dispose of any idea that its recorded lapses were due to the medium's restlessness; and it should laugh out of court the suggestion that enough "ectoplasm" was abstracted from the medium to bring his weight below the sensitive limit of the apparatus. The fact that the medium was in no species of trance should outlaw the various other oblique explanations of his activity. The claim is made that fifteen seconds is an absurdly brief interval to convict a man on; but this is utterly contrary to fact—in terms of the simple phenomena of these seances, fifteen seconds is an enormous time.

Numerous wise folk of the offensively hard-headed type have scoffed at the elaborate methods used. It is much simpler than that to trap a medium, they say; one needs only to flash a light. Replying sarcastically, we should exclaim: "What a pity we did not think of that!" Meeting these gentlemen on their own level, we should point out that after sitting in total darkness for an hour or more, the flashing of an adequate light would leave one blind and confused for a time quite sufficient to enable anything suspicious to be covered up. Making the simple statement that we had promised not to flash a light, we should doubtless shoot far over the heads of these critics. But even so, they must realize the dictates of expediency. Surely the way to establish our veracity against the medium's is not to start from a broken pledge; surely the way to get more mediums to come forward is not to employ bar-room tactics with the first applicant. If questioned why we ever made such a pledge, the answer may be again on the ground of expediency—though we prefer to answer by saying once more that we are not investigators of the sort who "know" before they start that the medium is a fraud; and that, if there be genuine mediums, there is very good reason for not flashing a light while they are at work. We hope it is settled that our investigation is a matter of science, not of assault and battery; and that any medium may come before us with the expectation of proper and courteous treatment.

On grounds which we have already catalogued in rebuttal, we have been criticized as unduly credulous. There has been the assumption that our reports would lean toward the psychic side, and the attempt to discount them in advance on this expectation. We hope the outcome of our first tests will have spiked this idea that we are convinced before we start, and will have made it clear that any favorable report which we may render will be based upon facts calling for such report.

On the other hand, all psychic believers must realize that our conditions and procedure were proper. Indeed, when sitting under very sharp controls, the medium felt so free from restraint that he displayed some impatience to know when the tightening-up process was to begin. We will say very frankly that, in our view, anybody who objects to the conditions of these seances as in any way inhibitive of the best action of the psychic forces would better admit explicitly that any apparatus or any methods whatever that look toward the prevention or detection of fraud are inhibitive.

It should be remembered that we have not sat with all mediums, or even with a medium of wide reputation, generally admitted to have produced surprising results under reasonably severe conditions. We have sat with a single medium, and have had a very mediocre performance, not even up to the standard of high-grade fraud. Total darkness made it a matter of some finesse to demonstrate its true nature, but that is the best that can be said for it.

Accordingly, it is necessary to refrain from drawing unduly general conclusions from the present findings; and this necessity cuts two ways. That all mediums are frauds and all phenomena fraudulent is either true or false; but nothing tending to establish its truth or falsity has come out of these three seances. On this slender basis one might as well conclude that all mediums are from Pennsylvania, as that all indulge in trickery. Equally, one should not get the idea that professed psychic researchers are called upon to deal with nothing less trivial than the phenomena presented to us by this medium. The charge of incompetence has been brought against psychic investigators in general, because of our rapid success in winding up this case; but such charge is quite contrary to the facts, and demonstrates only the ignorance of those who bring it.

Mr. Lasker on the Shipping Board

THE PERIOD of two years, for which Mr. Lasker, at the request of President Harding, agreed to undertake the chairmanship of the Shipping Board and endeavor to bring order out of chaos having elapsed, he announced his retirement, and in a report to the President gives a concise statement of what has been accomplished in his "gigantic task of salvage and organization."

A gigantic task truly, for not only was the investment of public funds thrice that of any commercial enterprise in history, but conceived as a war-time effort and praiseworthy as such, it was an attempt to create a vast merchant marine by compressing into months the natural growth of generations, and inevitably "was doomed to disaster." Thus, Mr. Lasker tells us that the administration of the fleet "was not remotely competent"; that the boats had lost the confidence of American exporters; the operating deficits averaged $16,000,000 a month; "no accounting system worthy of the name existed"; and an unrecorded residuum of $150,000,000 war claims remained to be settled.

One of the seemingly unsolvable situations confronting the new Board was the 56 shipping companies, who had bought 184 ships at war-time prices, and, because of an 80 per cent decline in ship values, were bankrupt or facing bankruptcy. After months of study, 40 of these concerns were rescued and "preserved for the American flag." The Shipping Board has now "the most complete and accurate accounting system in the Government service," and the Director of the Budget recently stated that "the Shipping Board is the only Government agency with a monthly trial balance." By June 30 the Board had practically settled at 12 cents on the dollar the above-mentioned claims amounting to $150,000,000.

The Emergency Fleet Corporation, charged with the commercial operation of the ships, has reduced the monthly deficit of $16,000,000 to $4,000,000 a month, and has provided nearly two-score freight lines, giving efficient service on every ocean trade route. Passenger and freight ships flying the American flag have brought the United States six days closer to South America, and in the Pacific are rapidly expanding trade relations with the Orient. It is believed that with the entry of the "Leviathan" into service we shall make rapid progress in the North Atlantic, where the competition is keenest.

On taking office, the Chairman promised to offer a policy which might prove the basis of a permanent merchant marine. On this score Mr. Lasker emphasizes the fundamental difficulty that physical operation costs are from 10 to 15 per cent higher than on foreign vessels, the difference being due to legislative restrictions, higher capital charges, better wages and better living conditions for the crews. The so-called Subsidy Bill aimed to equalize the conditions. Since Congress failed to pass this measure, "the apparent alternative is to go the full length of Government operation." Because of the inherent disadvantages of this, as compared with private ownership, the Board has advertised its established lines for sale. The result has been disappointing, and, in view of this, it is believed that "the Government is warranted in assuming the task of direct operation." Justification is found in the guarantee, thus afforded, of an adequate merchant marine in the event of war.

So Mr. Lasker recommends the operation by the Fleet Corporation of twelve to eighteen subsidiary corporations, whose general policies it shall control. This control should be with a view to ultimate sale to private owners. Such a scheme will call for 250 ships of 2,000,000 deadweight tons. This will leave 1200 surplus ships, many of which are inoperable and should be broken up. Of the balance, 200 ships of 1,750,000 tons deadweight should be selected as a reserve. The above vessels, plus our coastwise ships, would give us a merchant marine of 7,500,000 tons deadweight, a total which would place us in second position among the maritime powers.

The Demand for Air Laws

DURING the year 1922 there were 134 airplane accidents involving 69 fatalities, and 107 persons were injured through airplane accidents An analysis of this record by the Aeronautical Chamber of Commerce of America, as given in its annual report to the Secretary of Commerce, strongly stresses the fact that, if casualties are to be reduced, the Government must provide air laws and exercise jurisdiction over all civil flying. Just why civil flying is specified will be obvious from the following facts:

In 1922 approximately 1200 civilian airplanes were in operation in this country and between 550 and 600 were owned by individuals and organizations who possessed fixed bases and practiced conservative business policies. An equal number were distributed among itinerant pilots who have no particular system and depend for a living upon stunting, barnstorming, tours and extra hazardous assignments. In view of these facts, we are not surprised to learn that during the year there were 122 accidents among the itinerant or gipsy pilots and only 12 among the fixed basis operators. These accidents, we are told, resulted in 62 fatalities among the gipsy pilots and only seven among the fixed-basis operators. Analyzing the accidents among gipsy flyers, the report states that 37 were due to lack of inspection of their equipment, and that these would have been prevented by Government licensing and other regulations. Poor piloting caused 46 accidents, 39 were caused by stunting, 11 were caused by carelessness on the flying fields, 14 were due to lack of landing fields, and nine due to lack of data concerning the flying route, as a result of which the pilots became lost and were driven off their course.

The moral of all this is the urgency of the call for Federal regulation. Year after year our Congressmen have been urged to pass laws for the regulation of flying and the licensing of pilots, etc., and year by year they have been neglecting this duty which they owe to the nation. It is not only that there is a deplorable and unnecessary loss of life, but these ever-recurring

Our Point of View

tragedies disturb the public mind and prevent people from investing in a system of transportation which they wrongly believe to be not yet safe and practicable. No thoughtful person who contemplates the achievements in aviation can doubt that it is destined to prove as serviceable in peace as it did in the World War; but its extensive commercial development will never be assured until Congress is aroused from its present indifference. This awakening will come just as soon as constituents bring pressure to bear upon their representatives to pass the greatly needed legislation.

Does Railroad Electrification Pay?

THE QUESTION as to whether the change from steam to electric traction on steam railroads results in a net profit, is difficult to answer. Many notable substitutions of this kind have been made on our main railroad systems, the first great venture of the kind being the electrification of the four-track system of the New Haven Railroad between New York and New Haven. It is true that in the total length of line thus converted there are others which surpass it, notably the electrified mountain division of the Chicago, Milwaukee and St. Paul Railroad. The preeminence of the New Haven electrification is due to the fact that it covers a four-track main line which carries an extremely heavy passenger traffic, probably the heaviest of its kind in the world, to say nothing of its heavy freight traffic. The work included the service into and out of the New York terminal, with the immense amount of switching and the multiplied train movements, both passenger and freight, which are involved in a great terminal of this kind.

The electrification of the New Haven system was forced upon the company by the legislative demand that they should abolish steam traction at the New York terminal; and the change was regarded in railroad centers as a more or less doubtful experiment on a vast scale. The original installation covering the 33 miles from New York to Stamford, Conn., was followed by extension of the electrification to New Haven, and then the complete electric operation of the heavy freight traffic. Naturally, the engineering world has awaited with no little interest the publication of the relative economy of steam and electric traction, developed on this great scale. The results have recently been made public in an article by Sidney Withington, electrical engineer of the New Haven System, in an article published in the *Railway Review*, in which the writer emphasizes the fact that while the "direct" savings can be accurately tabulated and make an excellent showing, they will not in themselves usually justify electrification—this because of the heavy overhead charges due to the high first cost and other considerations.

On the score of direct savings due to reduced fuel consumption and motive power maintenance, we are told that, even after allowing for recent decrease in steam locomotive coal consumption, due to the use of superheated steam and other improvements, the annual saving in fuel due to electric operation is about 200,000 tons of coal per year. The significance of this result will be appreciated when we learn that the electrified rolling stock includes 103 electric locomotives and 79 multiple-unit cars with an annual mileage of 4,928,000 locomotive-miles per year, 53,397,000 car-miles per year and 2412 million ton-miles per year. On the other hand, the charges against electrification includes interest, depreciation and taxes on the heavy additional investment; the operation and maintenance of the transmission and distribution system; and other minor items of cost which do not figure in the cost saving, as given above.

To the credit of electrification are to be placed the many favorable and incidental advantages resulting from the change. Thus, multiple-unit equipment has simplified terminal switching and dead-head movements, and has speeded up operation, especially during the rush hours of the morning and evening. Also the necessity for extra track facilities has been postponed for a number of years. And the credit for the saving in the cost of such construction must be granted to the electrification. Furthermore, the passenger tracks at the Grand Central are on two levels, something which would be impossible under steam operation. Therefore, electrification must be credited with having reduced the necessary terminal area, which under steam operation would have to be twice what it now is. Also most important is the fact that the area above the present terminal is available for commercial buildings, and the revenues from this source we are told, if capitalized, amount to more than the entire cost of installation in both the New York Central and New Haven electrified zones. This, of course, is a special local condition and will never apply in the electrification of stretches of main line which include no great city terminal.

Saving 160,000,000 Tons of Coal

WE HAVE no economical problem confronting the United States today that makes a more insistent demand for close attention than that of the conservation of our fuel resources. The annual consumption of coal and oil is increasing so fast as to lay heavy emphasis upon the prediction, so frequently made in these days by competent authorities, that the exhaustion of our fuel supplies is being brought within measurable distance. Hence, it is an imperative duty laid upon all large users of fuel, both to practice economy in its consumption and to utilize every source of fuelless power that can be rendered available. Preeminent among these is water power, of which the great rivers, streams and lakes of this country afford a vast potential supply.

Of the many proposals which have been considered and worked out on a practicable basis, the most ambitious and most carefully elaborated is that known as the super-power zone, which comprises the territory extending from Boston to Washington, and reaches inland from the coast for a distance of 150 miles. Speaking of this project, Mr. William S. Murray, chairman of the Super-Power Survey Commission of the United States Geological Survey, recently said: "If the electric utilities within this zone were to meet the future load requirements by extending their power facilities jointly in the construction of large hydro-electric and steam-electric plants, they would save yearly 50,000,000 tons of coal." He based this statement on the fact that the average fuel consumption of these utilities during 1919 was 2.76 pounds per kilowatt hour; and that if we were to include the coal rate for the railroads and the industries, this would mean that such a figure would be changed to not less than four pounds of coal per horsepower hour.

We have made wonderful strides in the development and use of electric power; but Mr. Murray points out that the last and greatly needed stage of electric utility expansion is still ahead of us. He believes that ultimately the separate electric utilities will go out of the power production business, and that they will receive wholesale electric energy from certain great power companies. These companies will be entirely outside of the corporate existence of the various electric utility companies, whose function, thenceforth, will be to distribute energy, so received, to the customers within their franchised territorial limits.

The super-power zone scheme involves of course a large dependence upon the hydro-electric possibilities of the Niagara and St. Lawrence Rivers, and in the close of his address at the recent commencement of Lehigh University Mr. Murray gave in some details his calculations of the amount of power which is running to waste on these rivers. Translating his totals into terms of coal consumption, he finds the utilization of these rivers would mean a saving of about 160,000,000 tons of coal annually.

The SCIENTIFIC AMERICAN is an ardent believer in the merits of the super-power zone scheme, and in the economic utilization of the immense reservoir of potential energy with which nature has enriched the United States on its northeastern borders. We say this with full consciousness of the sacrifice which would be involved of the spectacular features of the Niagara River; but, in view of the rapid increase of our population with its enormous future consumption of fuel, we feel that this at least is one instance where sentimental considerations must ultimately bow to the stern demands of utility.

A Great American Venture

THE PLACING of the "Leviathan" on the trans-Atlantic route in competition with the long-established foreign lines is the greatest single venture on the high seas in the history of the American Merchant Marine. It is a novel and trying experience, for, although we have run and are now running some pretty big ships in the trans-Atlantic passenger service, not one of them is comparable either in size or in complexity to the "Leviathan." There are critics who claim that only the older companies, with ample experience and a large trained staff to call upon, can place a ship on this route and run her successfully from the very day she enters upon active service. We all know the old saying: "Give a dog a bad name"; and if the "Leviathan" had started on her first voyage with a crew of between 1200 and 1300 men, unacquainted either with one another or with their officers or with the ship, and difficulties had developed in the engine room, on deck, or in the service of the passengers, there would have been a chorus of "I told you so's" from the sceptics, and the prestige of this great ship would have suffered a blow from which it might never have recovered.

The situation is well understood by shipping men. The foreign services, particularly the British companies, have always made it a point to run trial trips, with a large number of guests, for the purpose of "shaking down" a new vessel, not merely as regards her engine room and crew, but also in the dining room, stateroom and social service. Extended trial trips of this character were taken by both the "Lusitania" and the "Mauretania."

The "Leviathan" is much more than just a big ship. She is a gigantic steam power plant, equal in capacity to the large generating stations which furnish power to drive the subways and elevated systems of this city. She is an electric light and power station, with a plant sufficient to light a town of considerable dimensions. She is a large pumping station, whose machinery handles an amount of water which would suffice for the needs of a city, and lastly she is a first-class hotel, matching in her luxurious accommodations and her capacity for guests the very finest of our far-famed American hotels. It would be the very height of folly to throw together this great aggregate of men and machinery and expect it to function smoothly without preliminary tests and training. Hence it came about that, just as the Government sent the "Leviathan" on a five-day trial trip after reconditioning for the transport of troops, so now it has subjected her to a similar five-day trial after her elaborate reconstruction and reconditioning as a first-class trans-Atlantic liner.

The "Leviathan," as we have said, is a great American venture. Into the work of reconditioning has been put all the experience of the past and many new features which, as we have shown in the article elsewhere in this issue, are designed to render her the safest and most comfortable liner afloat. The men who have done this work, engineers, contractors, draftsmen, and even the working men at the yards, have regarded their task as something in the light of a sporting proposition, and we have reasons to know that hundreds of them have worked long hours of overtime without pay, believing that here was a chance to show that what we did 75 years ago, when the little schooner yacht "American" won out at Cowes, we can repeat with the "Leviathan" upon the trans-Atlantic course.

Our Psychic Investigation in Europe — IV

A Sitting with Evan Powell, the Well-Known Welsh Medium, that Was Very Rich in Phenomena

By J. Malcolm Bird

Associate Editor, SCIENTIFIC AMERICAN, and Secretary of the SCIENTIFIC AMERICAN Psychic Investigation Committee

WITHOUT any question the best seance that I had in England was that of Monday, March 12, with Mr. Evan Powell. Indeed, Sir Arthur, who has sat scores of times with Mr. Powell, stated after the sitting that each of the phenomena that this medium produces, he had seen better than they had occurred here; but that he had never seen such a satisfactory all-around demonstration of Mr. Powell's repertoire as that with which we had just been favored. There were many things done for which I could not conceive a rational explanation on grounds of fraud.

Mr. Powell was originally a Welsh coal miner; he has now progressed to the dignity of a coal merchant, doing a small local business. His quarters is down in Wales; he runs up to London once or twice a month to give sittings at the British College of Psychic Science; for these he refuses to accept a penny more than his actual traveling expenses. The College gets more than that for them—a guinea or thirty shillings or some such fee from each sitter, the profit going into the general funds of the College.

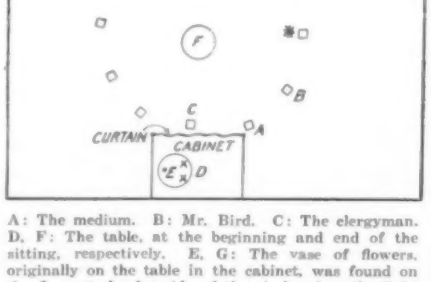
This medium is not one of those sensitive, shrinking souls who are so easily thrown off their psychic stride. It is his custom to sit securely roped into his chair—or at least, to all appearances securely roped; and he states that he has become so accustomed to this that he is more comfortable and produces more and better results when bound than when free. He reminds you, without waiting for you to broach the subject, that the phenomena are of no interest or importance unless the sitters can be satisfied that no fraud has been committed; and if you omit any of the elementary precautions he insists that you go back and remedy the oversight. Either he is a genuine medium, or possessed of unlimited confidence.

The "control," another American Indian named Black Hawk, has the same viewpoint; and he will not voluntarily permit one part of the program to be passed for the next number without having assured himself, by repetition if necessary, that all the sitters have seen or heard, and that all have expressed satisfaction with the particular phenomenon in question. Black Hawk drags the words "fraud" and "collective hallucination" right out into the open during the seance, and insists that unless the sitters are convinced that these possibilities have been eliminated, the seance is without value. Several times a light or a voice or a physical contact was repeated for the benefit of some sitter who had not been sure that it had happened; and more than once, after a particularly powerful demonstration, the sitting was held up while Black Hawk got us all to agree that it couldn't possibly have been collective hallucination. He was very bitter and very sarcastic about this "explanation."

Sir Arthur and I arrived together, and were taken to one of the upper rooms where the medium was having a nap. He had journeyed from his home to Crowborough, the day before, to give a private sitting at Sir Arthur's house. This had been a brilliant success—so much so that Sir Arthur feared it might have drained the medium to the detriment of Monday's seance. The fear turned out to be groundless.

We woke Mr. Powell, who explained that the nap was his custom, and not at all a result of Sunday's sitting. He finds the process of nervous anticipation the most trying feature of the whole performance, affecting his abdominal regions very unpleasantly—presumably through the solar plexus nerve-center; and whenever he can, he sleeps through this.

He knew that he was to meet an investigator of some importance from America, and he was prepared to force me, if necessary, to take what he regarded as due precautions against fraud. He stripped to his undergarments, and insisted that I search thoroughly all his pockets and examine his clothes with full care in other respects; and that I assure myself that the undergarments contained only himself. I was able to find nothing except his actual garments plus a handkerchief. Then he made me go with him to the wash room while he washed his hands in hot water to prove that he had no luminous substance on them; after which he demanded that I stick to him like a leech until we actually went into the seance room. Again I remark that he is necessarily genuine, or possessed of unlimited confidence; though, of course, if he were fairly sure that he had something that ordinary examination would not disclose, the insistence upon such examination would be the logical thing to distract the attention of the investigator. I always did in as slipshod a fashion as possible the things that I was asked to do, and devoted as much thought as I could to things that were not thus suggested. In Powell's case, I found absolutely nothing suspicious before the seance.



A: The medium. B: Mr. Bird. C: The clergyman. D, F: The table, at the beginning and end of the sitting, respectively. E, G: The vase of flowers, originally on the table in the cabinet, was found on the floor at the far side of the circle when the light was restored. The single crosses mark the position of the two clusters of bells at the beginning, the double crosses show where they were found at the end

Diagram of Mr. Bird's sitting of March 12 with Evan Powell, the celebrated Welsh medium

For the business of tying the medium in his chair, a single long rope was provided, and it was insisted that I do the tying, with the cooperation of another sitter who was much the same sort of outsider as I—a clergyman, anxious to see for himself what there was in the phenomena.

The back of the medium's chair was brought hard against one of the columns of the cabinet, and the chair was securely tied in this position. The medium then took his seat, and the reverend gentleman and I tied him in as well as we knew how. He was tied to the chair by ropes about his chest and abdomen; his upper arms were tied to the diagonal segments of the chair arms, and his wrists to the horizontal ends of these members; and his legs were tied to the chair legs. Finally the two ends of the rope were brought together beneath the chair and sealed with wax. Aside from this point, the only suggestions as to method which we received from Mr. Powell consisted in his repeated urging that we draw the ropes tighter—we finally got them much tighter than we should have dared draw them if left to our own judgment as to what might check the medium's circulation.

On general principles, one is suspicious of a tie made by passing a single length of rope many times about the body, arms and legs. There always is the feeling that by playing the slack—some of which always can be made—around from loop to loop until it is all on a single loop, the subject may escape from one of the loops; after which that whole loop becomes slack to be borrowed by the other loops. We guarded against this by putting non-skid knots on every loop. When the job was completed, it was plainly one that had been done by amateur hands. On this very account it would have been extremely difficult to untie the rope, and tie it up again in the same way; and so far as my memory enabled me to judge, the ropes were in the same state at the end of the sitting as at the beginning. I should perhaps be prepared to admit, for the sake of argument, that the medium might have been able to manage some way of getting free or partly free, without disturbing the ropes appreciably; that he could then have got back would require a much wilder stretch of the imagination to believe.

WITH the appearance in our July issue of the story of our first formal seances, it becomes more necessary than ever to distinguish between these serious scientific sittings and Mr. Bird's informal examination of European mediumship. This month we have nothing further to report in the way of serious investigation, so Mr. Bird's story of his European experiences must stand alone. It may not be out of order, therefore, to repeat that his trip has no connection with our investigation here, save as the experience gained may suggest procedures to be adopted in our American work.—THE EDITOR.

And yet, there was one feature that was profoundly unsatisfactory. Everybody knows that when a knot is tied in ordinary sewing cotton, it cannot be untied; the thread must be broken. As a final step in the tying, the medium's thumbs were tied together, as they stood annexed to opposite arms of the chair, by an 11-inch length of thread, tied very tightly about the base of each thumb and drawn taut across the space between them. Obviously, as long as this thread remained intact, he could not by any physical possibility *slip* his other bonds—he could have escaped them only by actually untying them. And such untying would be vastly hampered by the presence of the thread. If then the thread were found unbroken at the end of the seance, there would be but three possibilities to consider: that the medium had remained tied throughout, that the ropes had been untied and tied again, or that the thread had been broken and replaced. A fourth alternative is presented by the possibility that the thread might be broken, and remain so.

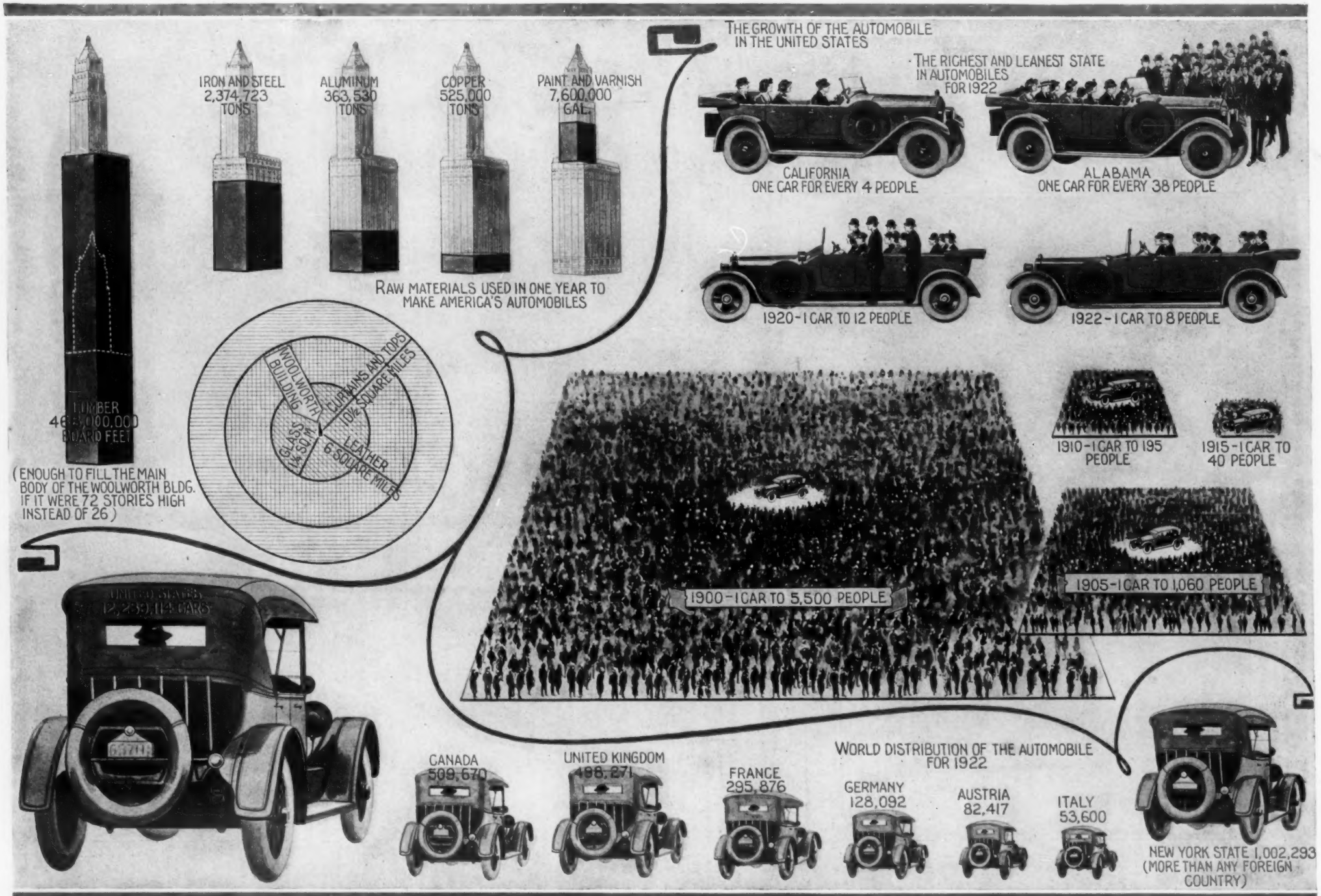
The second of these alternatives I am prepared to discard; the medium could no more have made a series of ties that would have looked like mine, than a competent carpenter could imitate a house that I might build myself. The third alternative could apparently have been effected only with the aid of a confederate; the medium had no thread if my search of his garments and person was an adequate one. Moreover, when we came to remove the thread from the bases of his thumbs at the end, it was so tight that we could not even get under it to break it; we had to slip the point of a penknife under it and cut it. My best judgment would be that it was just as tight as this at the beginning; and that even if we waive the question of where the medium could get fresh thread and what he could do with the old thread, he could hardly have carried out this substitution.

This brings us at the same time to the fourth alternative, and to the one suspicious hitch in the whole proceedings. At the end of the seance, one of the ladies was about to go to the wall switch to turn on the red light, when the control stopped her with the words "No, not yet." He then addressed me, asking me to find the medium's thumb on my side, which I did. He instructed me to pull on this thumb to insure myself that the thread was intact, which I did, apparently with the indicated result. Then he told me to pull harder and break the thread.

I think that if the suggestion had not been planted in my mind, by the preliminary pull, that the thread was intact, I should have realized the unwisdom of this request and refused to comply with it. As things lay, I realized it the moment after I had "broken" the thread—but then it was too late. The thread resisted my pull for an instant, and then came away; and for a moment I had no doubt that I had really broken it. Immediately, however, it dawned upon me that I had heard or felt no clean-cut snap, and that the sensation given by the yielding thread had been just as applicable to the pulling, out of the grasp of the medium's other thumb and finger, of a previously broken end. I really think it more probable that this was what happened, than that I actually broke the thread.

It may be rejoined here that the thread's integrity was immaterial, since I cannot show how the medium could have come free, even had it been broken. That is true enough. But it is also true that I do not know everything there is to know about ties and escapes; and that the thread was supposed to remain unbroken. If my impressions are correct as to what happened, the medium or the control thought the matter of sufficient importance to trick me about it. If the thread were really unbroken, it should have remained so until the lights were on and we should have been permitted to examine it. If it were

(*Continued on page 136*)



A GRAPHIC SHOWING OF AMERICAN AUTOMOBILE STATISTICS FOR 1923

As usual, the compilation of the automobile license figures for the old year shows that there has been a very large increase in the number of cars in use. This year we have put the comparison on a somewhat novel basis, and have shown just how the relation between the total population of our country and its total stock of automotive vehicles has changed in 22 years. This year it is for the first time reasonably possible to accommodate the entire population of the United States in our cars, if every one of the cars were available for the purpose: for each one would have to carry only eight passengers to achieve this result. When we run our eyes back over the figures for preceding years and come to the vast crowd of people who, statistically speaking, pertained to each American automobile in 1900, prediction as to just where the ultimate exhaustion point may be found must falter. The contrast between present figures for our most and our least completely automobilized States is another indication that there is plenty of room for more cars.

We all know that America is the land of the automobile—though one who confines his foreign experience to Paris and London might be pardoned for doubting it. That the comparison is so vastly in our favor, however, even considering our greater population, as the row of drawings across the bottom of the page shows, many of us must have failed to realize.

As car manufacturers, though the foreign buyer scorns our product when he can afford to do so, we stand again pre-eminent so far as quantity is concerned. Some idea of what the automobile industry means to the country may be gleaned from the graphic demonstration of the raw material used up by this industry. The drawings are self-explanatory here too, save that it may be in order to remind the reader that, as in its companion drawings, the vastly stretched-out Woolworth Building, which we have had to imagine for the lumber, is filled up solid with this commodity; and that the glass, the leather and the curtain-and-top material, which we cannot thus display in solid form, are all supposed to carpet the entire area shown. That is to say, these circles overlap entirely, being truly concentric circles instead of merely concentric and conterminous rings.

A Giant Among Gigantic Wind Tunnels

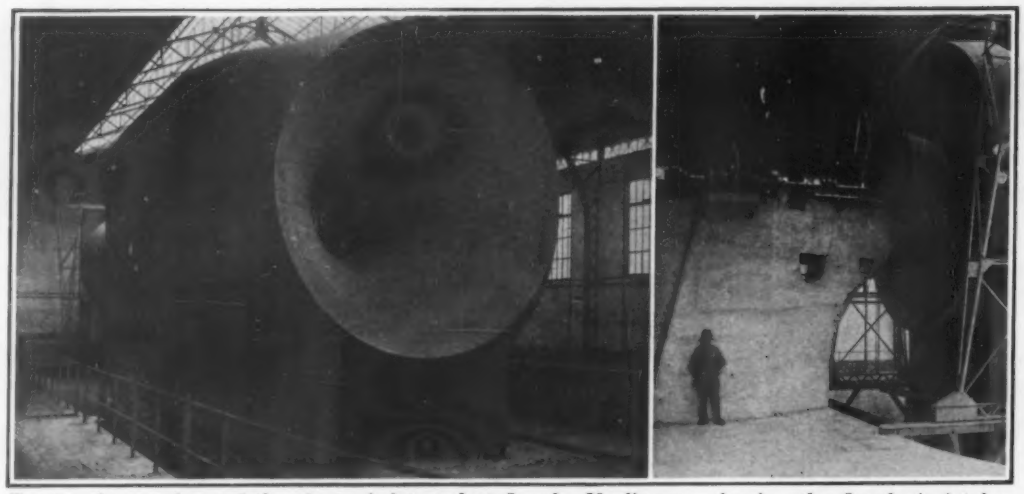
THE strange horn-like object which forms the cover picture of this issue is the huge aero-dynamic or wind tunnel recently constructed by the aeronautical engineers of the French army at Issy-les-Moulineaux, just outside of Paris. It is part of the magnificent equipment of a large aero-dynamical testing plant which occupies extensive buildings and plants, and which is intended to keep France well in the forefront in the matter of aviation.

The great wind tunnel is built of reinforced concrete and occupies an entire building of its own. It is a somewhat complicated structure on the inside, where the models of airplanes and airplane parts are tested in the strong rush of air. The tunnel measures 110 feet in length. At the front end is a flaring member which is designed to draw in air by means of a powerful fan located at the extreme rear of the structure. The mouth of the tunnel is about eight feet in diameter, while just back of this comes the square-shaped body the interior of which forms a good-sized testing chamber. In this chamber is mounted a structural iron frame which serves to hold the small models in the swiftly moving current of air. The chamber also contains numerous instruments for measuring the speed of the air current, pressures, angles of planes, lifting force, and so on.

By means of the excellent facilities provided by this tunnel, it will be possible to determine with extreme accuracy the performance of any proposed plane, or any parts to be used in connection with aircraft.

Behind the testing chamber of this wind tunnel there is a long tunnel some 10 feet in diameter, which extends clear to the rear of the structure. At the rear end of the tunnel is the great air fan driven by an electric motor. The fan provides for a maximum speed of air current of some 240 feet per second. As a general rule, however, the speed is below this maximum, and is regulated by means of the electric motor. The blades of the fan are also made adjustable so that they can be set at different angles for varying the wind current. The air fan is about 20 feet in diameter.

This wind tunnel has been constructed after the design of the famous engineer, Gustave Eiffel.



Front and rear views of the giant wind tunnel at Issy-les-Moulineaux, showing the flared air intake and the motor-driven suction fan

A Model Railway in the Workaday World

THE Eskdale Railway, said to be the smallest public railway in the world, presents features of great novelty and interest. At first sight it is difficult to regard it seriously, and our illustration will inevitably provoke a smile. Nevertheless it is not a toy or model but is of real commercial utility, and as an engineering feat on a small scale, it is unique. It is, in fact, the result of a remarkable development of the model locomotive beloved of most boys and indeed by many more adults than one might suppose.

Constructed in 1876, the line was originally of two feet nine inch gage and was used for the conveyance of iron ore from mines in the neighborhood of Boot, a little village in Eskdale, to Ravenglass on the coast of Cumberland, where it joined the Furness railway. After serving a useful purpose, both as regards mineral and passenger traffic for many years, the mines at Boot were closed down and after valiant efforts to maintain it, the railway itself fell into disuse in 1913. In 1915, however, a company known as "Narrow Gauge Railways, Ltd.," obtained a lease of the line which they converted to 15-inch gage, the original rails, weighing 40 pounds a yard, being relaid. The line was then equipped with the biggest model locomotives and rolling stock in existence, constructed by Messrs. Bassett-Lowke, Ltd., the well-known model railway makers of Northampton and London.

The line is just seven miles long. Starting from the terminal station at Ravenglass, with its single platform, it passes through four intermediate stations: Muncaster (1¼ miles), Irton Road (4¼ miles), Eskdale Green (4¾ miles) and Beckfoot (6½ miles) ending at Boot half a mile further on. After leaving Ravenglass the line drops down to Muncaster which is only 17 feet above sea level, but subsequently it rises by a series of sharp gradients—in one case as steep as 1 in 35—to a height of 210 feet at Boot. It passes through charming scenery, and, with Boot, or one of the other villages on the line as a center, delightful excursions may be made and grand panoramic views of the whole Cumbrian group of mountains obtained. Or one may visit Wastewater, one of the wildest and most picturesque lakes of the district, or climb Scawfell or one of the other mountains of the group. There is an excellent service of trains each way, both on weekdays and Sundays.

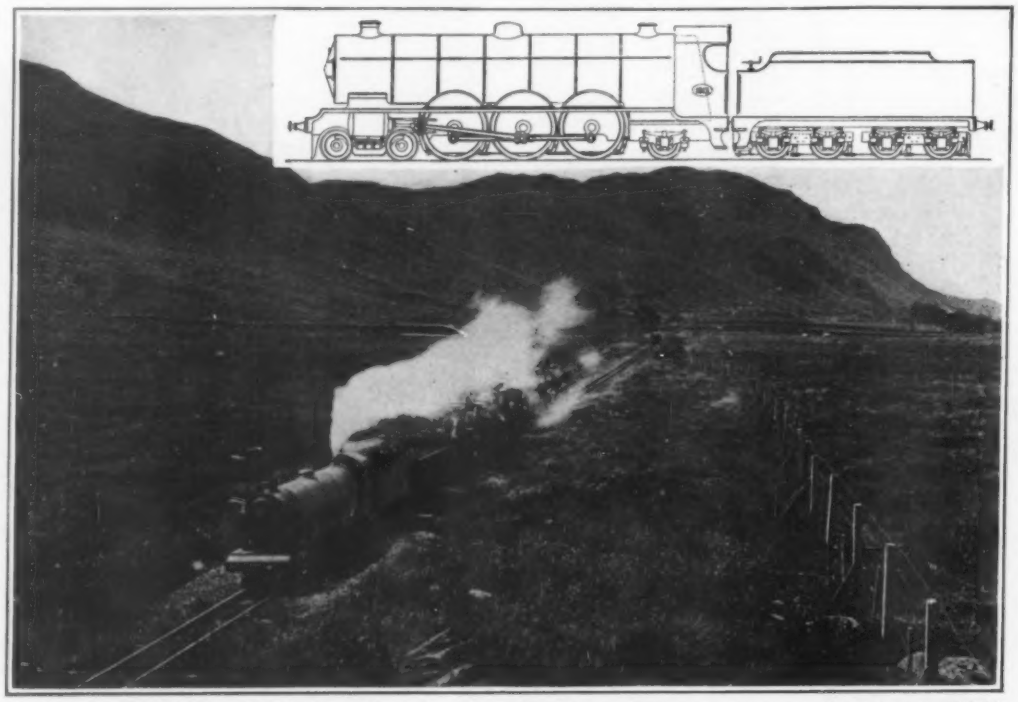
There is a hoary old joke against one of the big English railways to the effect that passengers are requested not to alight and pluck flowers whilst the train is in motion. We do not know whether the management of the Eskdale railway offer facilities in this respect to passengers, but at any rate persons desiring to join a train may do so at intermediate points between stations by means of hand-operated signals.

A maximum speed of 35 miles an hour is attained by the locomotives which are also capable of drawing a load of 17 tons on the level at a speed of 14 miles an hour—quite a respectable performance. The journey from Ravenglass to Boot occupies about 30 minutes, and about 76 passengers constitute a full load for a passenger train.

Each open coach accommodates eight persons (two abreast), the weight of an empty coach being about eight hundredweight. Wind screens and awnings are provided for protection in wet or in hot weather. For winter traffic, closed bogie coaches are run that weigh 24 hundredweight empty, and seat 12 persons inside and four on end platforms. An ordinary summer train comprises nine open coaches.

Without question the most fascinating features of the Eskdale railway are its one-quarter scale model locomotives. The most up-to-date models are of the "Pacific" type. The engines are fitted with superheaters, and the rolling stock is provided throughout with vacuum brakes. There are, in all, 5 locomotives, 23 freight cars and 27 passenger coaches.

It is an interesting fact that, whereas the development of narrow gage railways generally has been a matter of accommodating practice on broad and standard gage lines to smaller gages, in the case of the Eskdale railway it has been one of development in the opposite direction, namely, of improving upon the design of scale models and constructing model locomotives capable of doing really useful work.

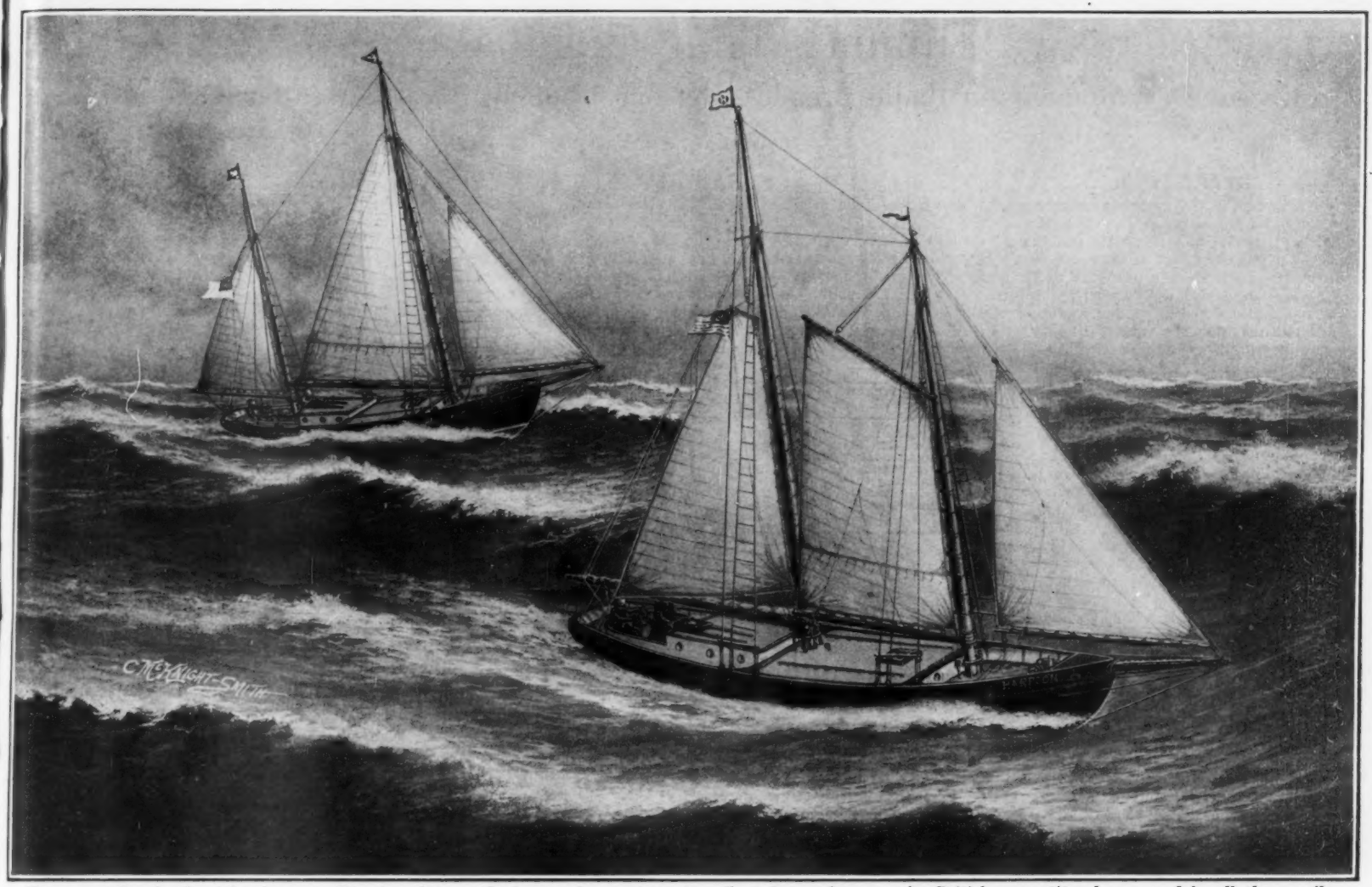


Scale, one-quarter full size. *Weight*, in working order with tender, 3 tons. *Length*, over buffers, 18 feet 2 inches. *Height*, to top of chimney, 3 feet 9 inches. *Working pressure*, 140 pounds per square inch. *Cylinders*, 4⅝ by 6¾ inches. *Heating surface*, 13,083 square inches. *Driving wheels*, 20 inches diameter. *Water capacity* of tender, 65 gallons. *Maximum speed*, 35 miles per hour. *Hauling capacity*, 17 tons at 14 miles per hour on level track

Eskdale railway passenger locomotive "Collossus," built by Bassett-Lowke of Northampton, England

Intelligence Tests and Immigrants

IN the *Scientific Monthly* for November, Professor Kimball Young discusses the results of applying intelligence tests to various immigrant groups in America. He points out that whereas up to the year 1882 the highest percentage of immigrants came from the British Isles and northern and western Europe, of recent years a complete change has taken place, the highest percentage now being from southern and eastern Europe. This change, he considers, is of the greatest importance for the future of America. If the more recent additions to America are of a less intelligent stock than the earlier inhabitants, then the consequences will be serious for the future. In order to test intelligence, the writer used the already well-known American Army tests, modified to suit the children he was testing, and he also considered the work of others studying racial differences by like methods. As a result of a very careful study he brings forward evidence to show that the intelligence of these southern European stocks is very much lower than that of the other stocks. If that is so, then the continued dilution of the original, more intelligent, stocks by these inferior ones will seriously affect the average intelligence of the population of the country. As a practical deduction, it is urged that there must be a complete change in public opinion on the desirability of large numbers of immigrants; and, secondly, that immigration must be controlled in the interest of the national welfare, new-comers not being allowed to enter unless they can read.



Heavy weather in the Atlantic race. The American yacht is carrying a storm trysail on her mainmast; the British competitor has a reef in all three sails

The Trans-Atlantic Race

In this Test of Skippers and Sail Plans the Two Hulls are Identical

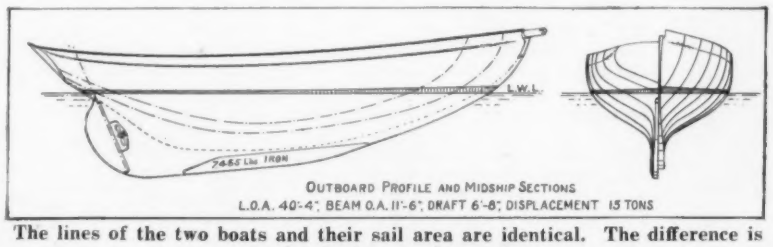
IN THE sport of yachting the present era must be written down as that of the small racing craft, which seems to have monopolized the field so far as international competition is concerned. With the exception of the race to Bermuda, the international competitions this season are represented by the race in British waters between American and British 6-meter yachts, and the trial of speed and skill in the trans-Atlantic race between the two very interesting 40-footers shown at the top of this page.

The two yachts were built in the spring of this year, one for the Earl of Leinster and the other for Mr. W. Washburn Nutting, editor of *Motor Boat*. It was stipulated that they should be 40 feet long overall; that they should be identical in the design of their hulls and in their construction; and that they should each carry not over 900 square feet of sail. Within the restriction as to total sail carried, each skipper was free to adopt the type of rig which he considered the best for an ocean race of this kind. Mr. Nutting selected the schooner rig, and the Earl of Leinster the ketch rig, which is greatly favored among British yachtsmen. The exact dimensions of each yacht are: length on deck, 40 feet 4 inches; waterline length, 32 feet 6 inches; beam, 11 feet 6 inches; draft, 6 feet 8 inches; displacement, 30,566 pounds. The iron ballast on the keel weighs 7465 pounds. The exact sail area of each boat is 877 square feet.

The yachts are both auxiliary, the Nutting boat carrying a 4-cylinder 2-cycle engine of from 12 to 15 horsepower, and the British boat a 2-cylinder 4-cycle engine of 18 horsepower. By the rules of the race each boat is allowed 150 gallons of gasoline and the skippers are free to use the engines when and where they will until the fuel supply is exhausted. The original proposal was to sail the race with only the skipper aboard; but it was realized that the pleasure of the race would be greatly enhanced with two aboard, and it was agreed that each yacht should carry a crew of two men.

The sail plan of the American boat shows that she carries a jib, a gaff foresail, and a jib-headed, leg-of-mutton, or Marconi mainsail, as it is variously called. Jib-headed sails have come into great favor of late years, not merely in small yachts such as these, but in the large racing craft, as shown by the fact that a request was made by Sir Thomas Lipton that he be permitted to use this type of mainsail on "Shamrock IV."

Mr. Nutting, who is an expert in deep-sea cruising in small yachts, has this to say in speaking about the respective merits of jib-headed and gaff-headed sails: "Every indication points to the fact that the jib-headed sail is the future sail for small craft. On the wind, other elements of the design being equal, the jib-headed rig is the faster, and I have noted that any wholesome type of boat that is fast to windward is more than middling across or off the wind." The ketch rig is favored by the British because of its excellent balance and the speed with which the ketch type can be snugged down in bad weather. It is not unlike the yawl rig which is so popular in America, with the difference that the mizzen mast, instead of being stepped at the extreme after end of the boat, is brought forward well inboard and carries a much larger sail than the mizzen in the yawl. It is needless to say that in rigging both yachts everything has been done to simplify handling.



The lines of the two boats and their sail area are identical. The difference is in the rigging, as shown above

Comfort and convenience in the accommodations are of supreme importance, and much careful planning went into the layout and fitting of the interior. A novel feature is the raised deck between the masts. This deck, as can be seen from our drawing, extends flush across the boat from rail to rail for the full distance between the two masts. The arrangement provides abundance of head room below deck and enables the yacht to clear herself quickly of seas which come aboard amidship. Aft of this deck is a sturdy house with a low deck on each side of it, which will be handy for the storage of waterbreakers, cases of gasoline and other dunnage. The cockpit, although small, is large enough to allow a man to get down out of the wind.

Below deck there are four full-size berths, and instead of fitting these with spring mattresses, they are provided with canvas, which, lying in a hollow curve, provides the flexibility of a hammock and is a safeguard against being thrown out of one's berth in heavy weather. Particular attention has been paid to placing everything so as to call for a minimum of handling and movement to and fro. Our drawing shows the two vessels snugged down in heavy weather. The American boat is carrying a loose-footed trysail on her mainmast, with a single reef in the jib and foresail. The British craft is carrying a reef in all three sails.

Summer Time and Radio

Recent Developments in Radio Broadcasting that Challenge Warm Weather Handicaps

By George V. Haskell

RADIO broadcasting is now on a full-time basis. Or, to put it another way, this is a radio summer. Thousands upon thousands who became radio "fans" during the long winter months are now maintaining a keen interest in radio, especially during vacation days. Radio receiving sets are still operating in many homes—and operating remarkably well, despite the thunderstorms and noisy "static" disturbances and the all-round reduction in radio efficiency, due to warm weather. And in the seashore home, the mountain home or lodge, the camp, the summer resort, the farm and elsewhere, the radio receiving set, especially in portable form, is very much in evidence. Even the touring motorist is now carrying a portable radio receiving set tucked away among his luggage, for an occasional bit of entertainment or for his daily news and stock reports and weather forecasts by the wayside or in the motor camp. So radio broadcasting is now becoming a summer convenience as well as an indoor pastime of the winter season.

Radio communication is at its very best during the cold, crisp winter nights. At such times there is a minimum of atmospheric disturbances or "static," as the noises of space are called. Then, too, the average receiving set reaches out to the remotest points in an astounding manner, as compared with the very much curtailed range during warm weather. Wintertime reception of speech or music is as clear as a crystal—clearer by a good deal than the usual telephone line. Indeed, the crystal-clear atmosphere of the winter is as transparent to radio waves as it is to the sight when viewing distant objects.

But with the approach of warm weather the atmosphere is no longer as transparent as it has been during cold weather. It becomes troubled; it loses much of its transparency; receiving ranges are cut down; radio telephone reception is blurred and distorted; extraneous noises grow in number and in volume. Radio programs are apt to be broken up in the most aggravating manner.

Again, warm weather is outdoor weather. Heretofore, the radio receiving set has been a rather cumbersome installation, calling for various pieces of bulky and delicate apparatus, particularly a heavy and messy storage battery, which did not lend themselves to ready transportation. The consequence has been that radio has been left at home when the average American sought the outdoor life of summer time and vacation time. Again, there has been a strong fear of lightning and the supposed fire hazard attending it in connection with the usual radio antenna or aerial, with the result that many a radio receiving set has been taken down and packed up and stored away with the first signs of warm weather.

It was so in the summer of 1922. The young radio industry encountered a serious slump with the approach of warm weather. The preceding spring and winter marked the real beginning of radio broadcasting. The radio industry had come into being with a rush, and a phenomenal volume of business was transacted within a few months. Stores were at their wits' end to provide the necessary stocks of goods for the ever-growing crowd of enthusiastic customers. It was a case of production, not selling. Meanwhile, the manufacturers were literally swamped with orders, and only by the most strenuous efforts did they succeed finally in matching up their production with the public demand. The stores, at last enabled to procure the necessary stocks of goods, took on all the goods they could carry in anticipation of a continued brisk trade.

Then, with little if any warning, the bottom fell out of the radio business. The public stopped buying with the approach of warm weather. The stores could not move their goods. The manufacturers, to their intense dismay, found many of their orders cancelled and the large flow of quantity production suddenly backing up on them. The natural sequel was a cut-throat slashing of prices such as no other business has ever witnessed. In many uninformed quarters it was freely predicted that the radio industry was a passing "craze," and that the boom had been pricked and would deflate to nothing in short order. But to the better informed, this state of affairs was simply a marked slowing up of the radio industry during warm weather, due to serious lack of foresight on the part of engineers and business men alike to provide for the radio dog days of summer.

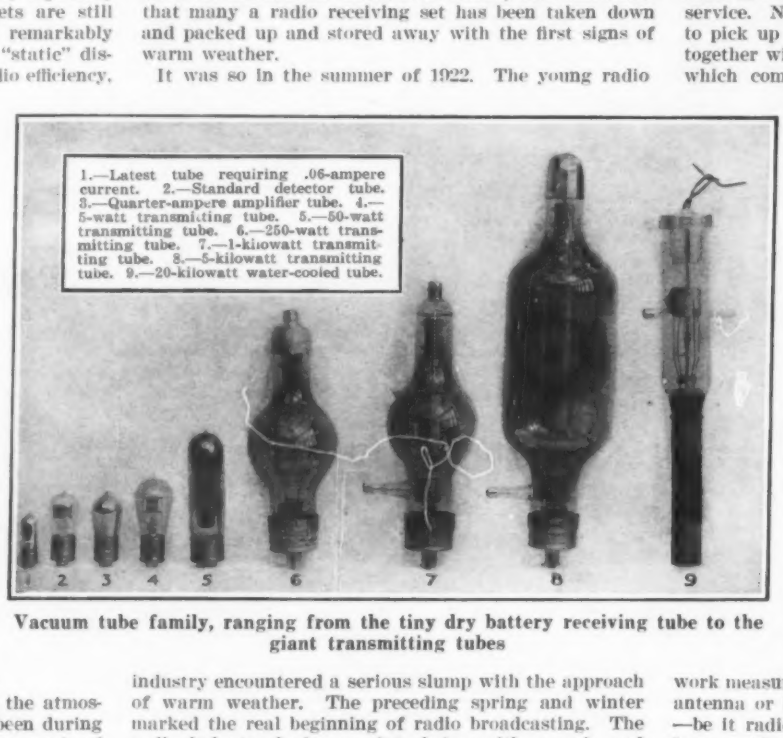
The decline in radio enthusiasm during the summer of 1922 may be attributed to: firstly, failure on the part of the radio industry, both from an engineering and business standpoint, to meet summer-time conditions and to maintain radio interest; secondly, the prevailing fear of lightning; thirdly, interference from static and the general lowering of radio efficiency.

But bygones are bygones and the radio industry, during the prosperous fall, winter and spring seasons just past, has had sufficient foresight, even during the brisk business months, to look forward to the coming warm weather and to provide for it. The result is that this summer finds us better prepared to enjoy radio at home and in vacation quarters, and it begins to look as though radio were at last promoted from a part-time job to a full-time one.

To begin with, considerable attention has been given to the summer ailments of radio. Today there are some eight hundred broadcasting stations in regular operation, blanketing every corner of this vast country, as compared with 150 or so during the summer of 1922. The consequence is that anybody, anywhere, with any kind of set, is reasonably sure of nearby broadcasting service. No longer is it necessary to strain every effort to pick up a long-distance radio broadcasting program, together with all the static and other interfering noises which come along with weak signals. Broadcasting stations today are powerful, and, when they serve nearby receiving sets, their signals are sufficiently strong to compete with all noises of space except those produced by a local thunderstorm. So the burden of overcoming summer-time radio ills has been tackled by the broadcasters to a large extent, which is as it should be. The logical starting point in tackling static is to produce powerful radio waves which can be intercepted by relatively insensitive receiving sets—sets that are fairly immune to most parasitic disturbances.

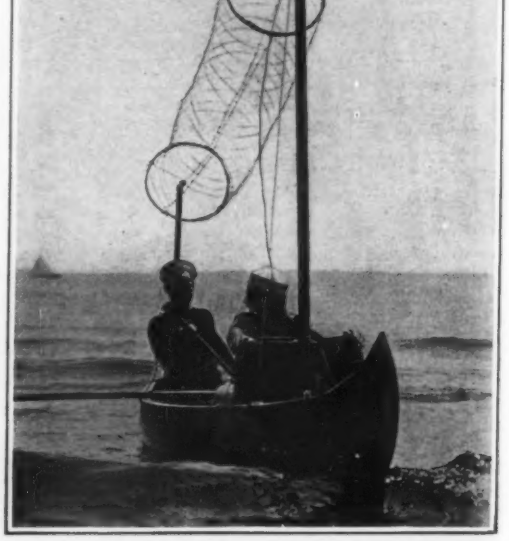
If one is satisfied with the nearby radio broadcasting programs, there is no reason why radio should not be enjoyed to the full during the warmest weather. The long and high antenna or aerial of cool and cold weather is replaced by a much shorter and lower antenna; or, what is still better practice, the outdoor antenna is dispensed with entirely in favor of a short indoor antenna consisting of a single wire tucked behind the picture molding and measuring anywhere from 20 to 50 feet long, or even a small loop consisting of four to eight turns on a wooden framework measuring three feet to five feet high. The smaller antenna or the loop will not intercept as much energy—be it radio signals or atmospheric parasites—as the large outdoor antenna; but allowing for the powerful signals of the nearby broadcasters, sufficient radio energy will be picked up to provide clear, clean-cut radio entertainment. It may be necessary, in some instances when static conditions are exceptionally bad, to use ear 'phones exclusively, temporarily doing away with the loud-speaker.

As far as lightning is concerned, there is little to fear just because one happens to have a radio receiving set. The possible dangers of lightning have been grossly exaggerated by the press, in many instances quite unconsciously at the very time the press was actually


1.—Latest tube requiring .06-ampere current. 2.—Standard detector tube. 3.—Quarter-ampere amplifier tube. 4.—5-watt transmitting tube. 5.—50-watt transmitting tube. 6.—250-watt transmitting tube. 7.—1-kilowatt transmitting tube. 8.—5-kilowatt transmitting tube. 9.—20-kilowatt water-cooled tube.
1 2 3 4 5 6 7 8 9

Vacuum tube family, ranging from the tiny dry battery receiving tube to the giant transmitting tubes

Typical portable receiving set making use of dry battery tubes and radio-frequency amplification



Ingenious form of helical antenna which can be readily carried about in collapsed form

trying to reassure radio laymen that there was no real danger if due precautions were taken.

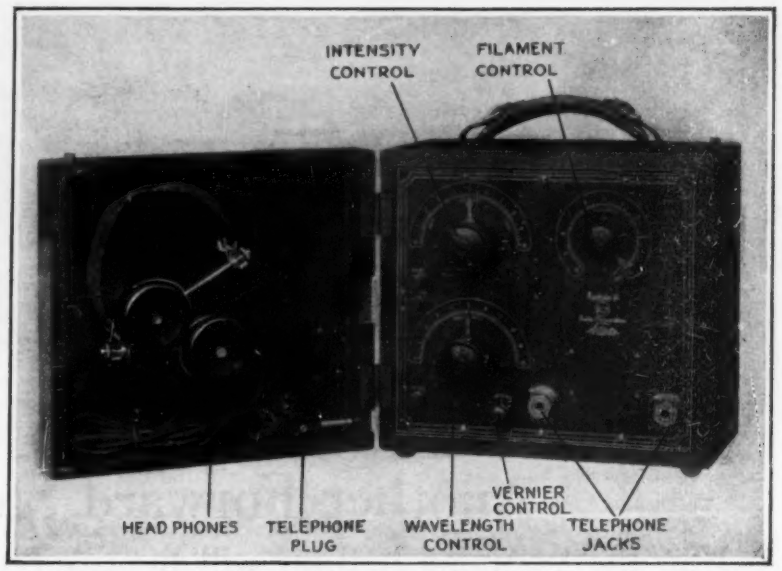
With the several million receiving sets now in operation, there has been no increase in lightning damage. On the other hand, there is no way in which property protection, brought about by the proper grounding of an antenna, can be estimated, but it must be considerable. The mere fact that lightning rods are again being considered in localities subject to severe thunderstorms, should be taken as a recommendation for a radio receiving set with a high, long and properly grounded antenna. The requirements of the National Electric Code, with specifications approved by the National Board of Fire Underwriters, are simple and effective, and when once complied with there should be no further fear from lightning hazards.

If a thunderstorm is raging in the immediate vicinity, one may as well bring the lightning arrester into play and lay the head 'phones aside. Distinct reception of radio telephone communications is taboo when the angry elements of the clouds are in action, since a local thunderstorm is one of the three outstanding factors affecting radio audibility. Static frequency and static audibility are the other two disconcerting forces that may interrupt the reception of grand opera or break the continuity of market reports by radio telephony.

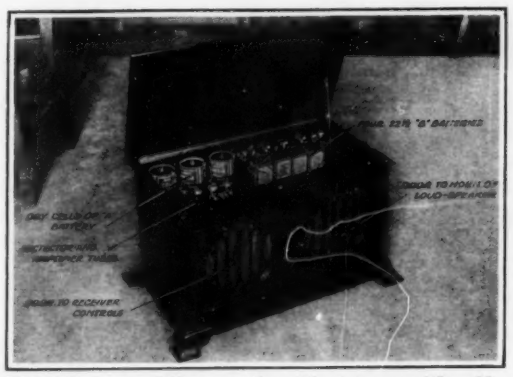
A series of experiments, cooperatively engineered by the Weather Bureau of the United States Department of Agriculture, and the Nebraska Wesleyan University, have been productive of conclusions that tend to introduce the question: "Can radio messages be heard in a thunderstorm?" Undoubtedly, if we are to accept the results of these scientific tests, the ability of a radio telephone receiving set to deliver speech or music in distinctly audible tones is thus impaired. In fact, the investigators into the subject of the relationship of weather conditions to radio audibility specify three outstanding factors as affecting the clearness of radio reception These, in the order named by M. P. Brunig of the Nebraska Wesleyan University, are: (1) Static frequency; (2) nearness of thunderstorm area to receiving station; (3) static audibility. However, the atmospheric conditions at the radio transmitting point do not exert an influence on the audibility of messages at a distant point. For instance, a local thunderstorm in progress in Washington during the transmission of a radio communication from the powerful radio station of the United States Navy Department, would not mar the clear reception of the message in New York City.

The fluctuations of the barometer—or the instrument for revealing the weight or pressure of the atmosphere—did not appear to influence the audibility of the radio signals. The absence of relationship between barometric pressure and the state of hearing of radio communications is cause for skepticism on the part of the Weather Bureau of the United States Department of Agriculture, that radio instruments may be employed as a direct means of forecasting weather conditions. Attaching some credence to the theory already advanced to the effect that the use of radio direction finders and the audibility of static or atmospheric disturbances in the radio receiving apparatus are agencies for foreshadowing the approach of storms, meteorologists contend that the essential factors for forecasting are still lacking. However, the Bureau of Aeronautics of the United States Navy Department, in experiments covering a period of years, conducted at Pensacola, Florida, and Hampton Roads, Virginia, claims that radio instruments have been effectively employed as weather vanes in foretelling the approach of hurricanes or violent thunderstorms that might prove disastrous to aviators.

Be that mooted question as it may, the results of the tests of the Weather Bureau and the Nebraska Wesleyan University have evolved the suggestion that weather forecast maps can be advantageously employed by radio transmitting stations to determine the handicaps or favorable conditions in the environs of the various radio receiving stations. In these particular scientific observations it was determined that a thunderstorm raging in proximity to the radio telegraph and telephone transmitting station of the Navy Department at Radio or Arlington, Virginia, exercised no effect on the reception of the communications by the Nebraska Wesleyan University, at University Place, Nebraska. A radio telephone message originating at this station during a local thunderstorm was heard distinctly at a distant point where no violent atmospheric disturbance was in progress. The barometer readings and the mileage to the nearest thunderstorm area were determined by use of a weather map of the United States for the corresponding twenty-four hours.



Another form of portable receiving apparatus, which will receive with a few feet of wire for the antenna

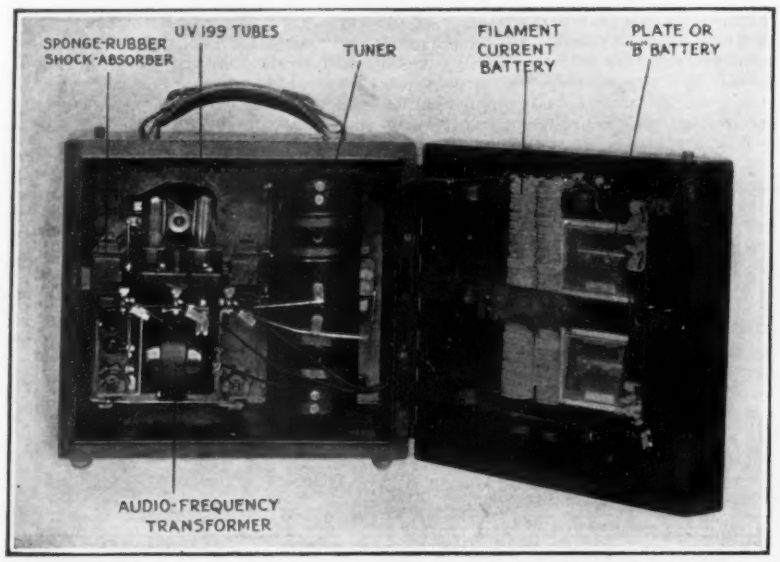


Receiving set of the console cabinet type, with self-contained dry batteries

All of which boils down to the conclusion that thunderstorms do not interfere with radio reception to any marked degree except when they are in the immediate vicinity of the receiving station. Static does not hinder radio telephone reception very appreciably. In this respect telephony has one great advantage over radio telegraphy. For instance, speech can be carried on after a fashion in extremely noisy public assemblies. The ease in understanding speech under such circumstances is due to our life-long experience. Then, too, there is what may be termed "assistance of context." By this is meant the ability of the average listener to fill in lost words which make sense to the entire sentence.

Since static and signal are amplified alike, it would seem advisable to suggest less frequent use of the loud-speaker in favor of head telephones, as already suggested, when intense static exists. Vacuum tube amplification, especially audio, should be reduced to a minimum consistent with signal strength.

Seldom, if ever, is a program from a local station seriously interrupted by static even when lightning flashes are plainly visible to the eye. The audibility of a signal required to obliterate completely the normal static interference is less than 200, and local stations will be found to produce at least 500 times audibility with the average two-stage receiver.



Interior view of portable set shown in upper right-hand illustration

Under the old scheme of things—and anything over a year old is apt to be termed "old" in such a young and progressive industry as radio—the equipment used for receiving over fairly long distances was quite cumbersome. The vacuum tubes—those little lamps which are the heart and the ears and whatnot of the usual radio receiving set—have been steadily developed. The first vacuum tubes employed in broadcasting reception required a six-volt potential and somewhat over one ampere of current for each tube. The heavy current drain even when using a single tube, necessitated the use of a storage battery for the filament energy.

In due course these first vacuum tubes gave way to others which made use of special coated filaments instead of the plain tungsten wire, and which required somewhat less than one-quarter ampere for each tube. One of these tubes operates on a single standard dry cell, and therefore lends itself to use in a portable receiving set.

The latest type of economical vacuum tube requires somewhere between 3 and 4 volts and a current consumption of .06 ampere—or a trifle more than one-twentieth ampere. A single tube of this kind will operate on three cells of flashlight battery, and three tubes of this kind can be operated for a long period of time on three standard dry cells.

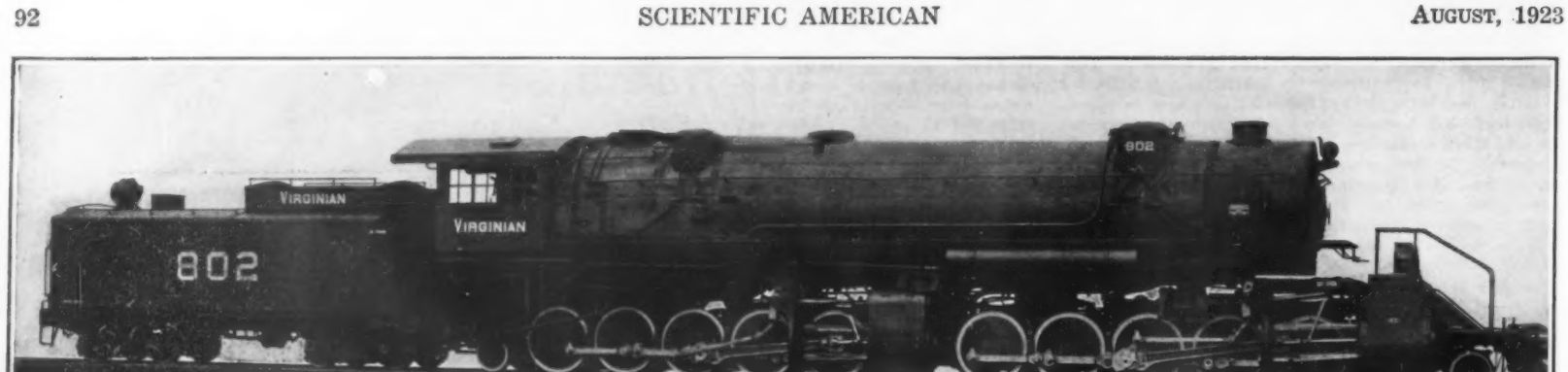
Due to these economical tubes, it is now possible to produce a receiving set which disposes with the former cumbersome storage battery and which, through the use of several tubes for amplification of signals, is of such extreme sensitiveness as to operate on any kind of a temporary antenna, or even a small loop. There are now being produced several types of portable sets which are considerably smaller than a small suitcase. These sets are self-contained, with the filament and so-called "B" or plate battery neatly mounted in the case.

The portable sets with their dry cells have taken radio quite outside the home circle when occasion demands. This summer the radio enthusiast has no excuse for not taking his radio set with him on his vacation trip, especially in view of the redoubled efforts of broadcasters to provide better entertainment features, more sporting events, better news service, and so on. The new wave length schedule, now in force, has also contributed materially to the betterment of broadcasting.

A German Motorist's "S. O. S."

THE slump in German currency necessitates the payment of many thousands of marks for motor cars. One would-be purchaser, however, has hopes of getting over this financial difficulty by the assistance of the British Automobile Association, which has received the following naïve appeal:

"I beg you pardon, Sir, if I come to you with a beg. I am very interest to the Motor sport, and that I have not enough money to buy one motorcar I would you beg to send me some £. If you will not I beg you to ask your colleges that the give me some £. I have one good motorcar to buy. I was thankful to you if you despatsch some £ as early as it goes."



This locomotive, the heaviest in existence, with a tractive effort of 176,600 pounds, is one of the many powerful steam units which are to be replaced by electric locomotives with a tractive effort of 277,500 pounds

Another Forward Step in Electrification

How the Virginian Railway will Replace Steam with Electricity for Hauling Heavy Trains

WHEN the late Henry H. Rogers decided shortly before his death to use his own private fortune to build a railroad of the highest standard and immense capacity through the coal fields of West Virginia, many people thought that his judgment had begun to slip. Scores of advisors sought to save him from the results of his folly, and few people believed that the Deepwater Tidewater Railway—or Virginian, as it is now called—could ever be financially successful. But events showed that Mr. Rogers' intellect had lacked nothing of its keenness. Within a very few years after operations were started in 1909, the Virginian Railway began to make money and it soon began to make records for earnings that are the envy of almost every railroad in America. For example, the ratio of its operating expenses to gross earnings in 1922 was 65.44, whereas this same ratio for two other roads running through the same district were respectively 75.27 and 79.2.

There are three chief reasons for the success of this road: In the first place, it obtains continually increasing traffic from the Pocahontas-New River coal fields through which it runs. Secondly, it was constructed so as to keep operating expense at minimum, with the lowest grades and the smallest number of curves that the character of the country permits. Finally, it operates its trains in accordance with a system known as "mass transportation," which is undoubtedly the most economical method under the existing conditions.

By mass transportation is meant the handling of the traffic by the largest possible trains instead of a much greater number of small trains. In accordance with this policy, the Virginian operates the heaviest trains of any railroad in the world, hauls them with the most powerful steam locomotives obtainable, and has had special 120-ton coal cars and double-duty air brakes designed to suit its special service.

With this equipment, seven million tons of coal can be hauled annually from the mines to the sea at Norfolk: and until recently, this capacity was ample. But now the production of the mines served by the railway has reached this figure, and unless the traffic capacity of the railway can be increased in some manner, a definite limit has been set to the output of this important district.

The trouble lies at the grades over the Allegheny Mountains. Elsewhere the coal moves freely enough; but for crossing these mountains, 8000-ton trains must be cut down to 5500 tons, and even when each of these smaller trains is handled by three compound articulated Mallet locomotives, speeds exceeding seven miles an hour cannot be secured.

This electric locomotive will haul 6000 tons up the mountain grades at 14 miles per hour, as compared with steam haulage of 5500 tons at 7 miles per hour

Two things can be done to remedy this situation. More tracks can be built, or greater power can be applied per train so as to move the trains up the grades at higher speeds. The first alternative involves considerable expense; while the second is impracticable with steam operation, for the simple reason that the 6000 horsepower now being applied to each train represents about the maximum power that can be obtained with the use of steam locomotives of any known type.

Electrification, however, provides a way out. By using a total of 20,000 horsepower of electric locomotives per train (which is by no means the present maximum possible limit), trains of 8000 tons can be taken up the grades at 14 miles per hour. This practically doubles the present capacity of these tracks and still provides a considerable margin for future expansion. In addition, since electric locomotives require much less care than steam locomotives, are available for a far greater proportion of each 24 hours, and consume power more efficiently, very material operating economies could be obtained by their use. For these reasons the management of the Virginian decided to electrify the mountain section of the road, where the difficulty is centered.

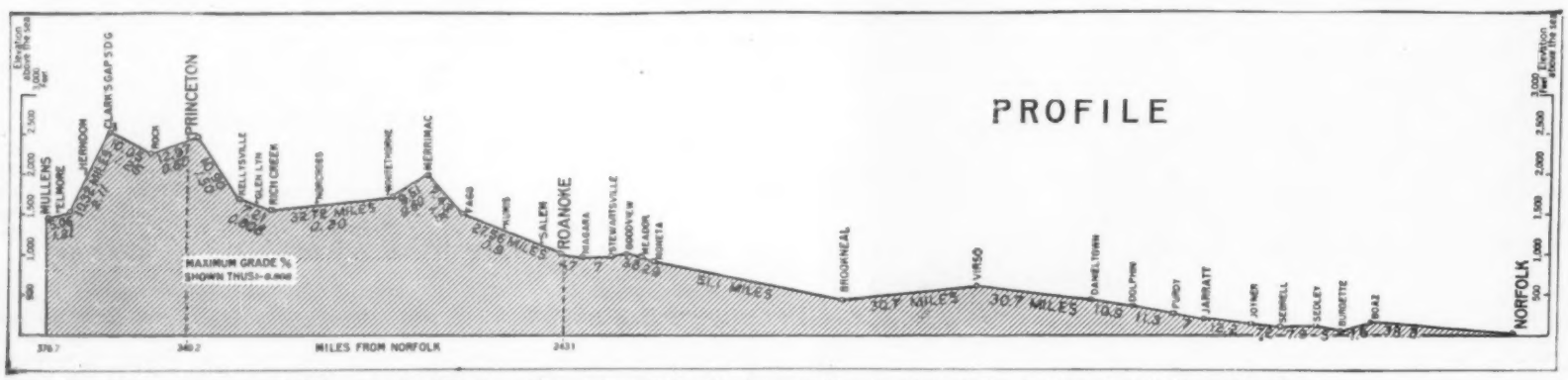
The system adopted, according to Mr. R. L. McLellan, railway engineer of the company that is supplying the electrical equipment, is the alternating-current, single-phase system with an overhead trolley similar to that used with such success on the Norfolk & Western, New York, New Haven & Hartford, the Pennsylvania Railroad at Philadelphia, the Grand Trunk, the Boston & Maine Railroad, and the Erie Railroad, the Spokane and Inland Railway and the Chicago Lake Shore and South Bend Railroad.

Each locomotive will have the following characteristics:

Total weight, approximate	600 tons
Weight on drivers	450 tons
T. E., continuous	135,000 pounds
T. E., maximum	277,500 pounds
Speed	14 or 28 M.P.H.
Horsepower, continuous, at 14 M.P.H.	5115 H.P.
Horsepower, continuous, at 28 M.P.H.	5970 H.P.
Diameter of drivers	62 inches
Length over coupler knuckles	145 feet 8 inches

The locomotive will receive current from an 11,000-volt trolley wire through pantograph collectors; this current will be stepped down by transformers in the locomotive cabs to a low voltage and delivered to the

(*Continued on page 141*)



Profile over the Allegheny Mountains of the Virginian Railroad, which is about to be electrically equipped

Light Weight Cement Slabs That Take the Place of Lumber in Building Operations

CEMENT slabs recently developed by a New Jersey manufacturer are proving of interest to architects and engineers because of their lightness, strength and adaptability to a variety of building operations. The slabs are in sheet form with a thickness of one inch, while in weight they average about 55 pounds to the cubic foot. Six hundred pounds to the square inch is claimed to be the crushing strength, and where this is not strong enough the slabs may be covered with a cement finish varying in thickness from 1/16 inch to ½ inch.

An interesting method is employed in making the slabs. A material resembling paraffin wax is mixed with the cement and sand, and after the correct amount of water is added the mixture is thoroughly mixed and poured into a steel form where the reinforcing wire netting is already placed. When the cement has set to the required degree of hardness, the slabs are removed from steel forms and placed on steel cars to be transported and placed in a steam tank where the slabs are exposed to the action of exhaust steam. Here the slabs are heated rapidly so that the waxlike material melts and runs into tanks below. One-half to three-fourths of this substance is extracted in this manner. In order to remove the balance of the waxlike material, superheated steam is admitted to the tank until a temperature of approximately 300 degrees Fahrenheit is obtained. In order that all traces of the chemical may be removed, it is necessary to carry on this steaming action for 24 hours. After a few hours of cooling the slabs are removed to a steam curing room where they are kept wet and hot for two or three days until they have the necessary strength for building purposes. Contrary to what might be expected, they do attain ample rigidity for all requirements.

By the melting of the waxlike material a very porous and light slab is formed, but it still possesses the important merit of great strength. When the slabs are used in building operations in connection with stucco structures, the siding slabs are nailed to wooden studs having the rough face out. This rough face then serves as a base for the stucco. Nails may be driven through the slabs easily without any danger of breakage. Owing to the peculiar air cell structure of the slabs, it is claimed they make good heat and sound insulators. They will also prove useful in places where a material having decided fire-resistive qualities is needed, since exposure to heat, water or live steam has no effect on their strength.

Laying the cement slabs on steel girders to form a roof which is inexpensive and permanent

After the cement slabs have been laid to form a roof, they are coated with a cement finish as here shown

Dahlia Sugar

THE cultivation of dahlias has developed so many beautiful varieties, and the flower has been so much improved that it comes with something of a shock to some folks to learn that dahlias are to be grown on a commercial scale for the sugar to be obtained from their bulbs. They will also be surprised to learn that more dahlia bulbs can be raised to the acre in California than sugar beets. Nor does it cost more to raise them. However the dahlia bulb has less of sugar content than the sugar beet, so it will likely cost more.

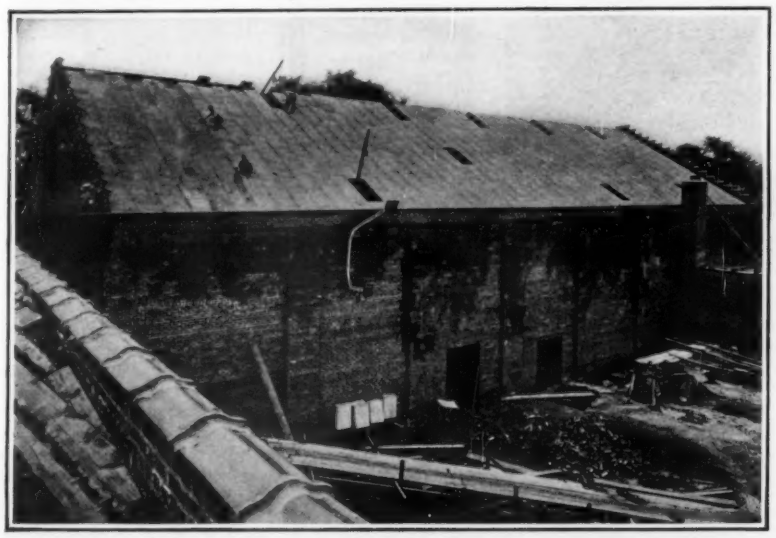
But there is a very good reason for dahlia sugar and that is the fact that it is the only commercial levulose, or fruit sugar, which may be used in a no-sugar diet by patients suffering with diabetes. It appears from statistics on the subject that this disease is increasing in this country, and scientists have for some time been trying to find a sugar that people suffering from it may eat. At the present time, diabetic patients are almost altogether debarred from using ordinary sugar. Statistics state that there are 1,000,000 people suffering from this ailment in this country, so the discovery of a formula for making this sugar from dahlias is of great importance to the national health.

The new sugar is one and one-half times as sweet as cane or beet sugar, and will hardly be a rival to the other sugars, as it will be more along the medicinal line. In this connection it may be mentioned that sugar was regarded as a medicine or a luxury in Europe up until the time that tea and coffee began to be universally used, and not a necessity, as it is now regarded.

The formula for making the dahlia sugar was worked out in the laboratories of the University of Southern California, and the head of this department, Dr. Laird Stabler, states that it is now complete.

It is said that diabetic patients have a great craving for sweets so it is a matter for rejoicing that they will not have to be wholly deprived of them as heretofore. The American people consume more sugar than any nation in the world, the consumption per capita in the last year being nearly a hundred pounds. This is an increase over the previous year. Saccharine was the only sweet allowed those suffering from diabetes, and there has been some controversy in the medical field as to whether this was not harmful to the digestion. It has no food properties, while sugar has, as it furnishes heat and energy for the body.

Perhaps when the dahlia fields get to growing, they will be allowed to flower, though this is hardly likely, as it will probably appear that it would detract from the amount of sugar stored up in the dahlia roots.



Permanent roof made of cement slabs, with the workmen engaged in giving it the finishing water-proof treatment

The Sensitivity of the Ear

UP to the present time there has been no satisfactory technique for loudness comparisons of different tones. At the meeting of the National Academy of Sciences in Washington in April, Dr. Donald Mackenzie of the Western Electric Company read a paper on the relative sensitivity of the ear at different tones. The reader gave a description of an alternation phonometer which makes it an easy matter to adjust to equal loudness two tones of different pitches. With this instrument a determination has been made of the relative sensitivity of normal ears of both men and women, over the pitch range from bass G to C5, at sound intensities midway between the faintest audible and the painfully loud. It is found that the sound energy necessary to produce a given loudness is smaller the higher the pitch, at least within the range examined. Different ears agree more closely at these intensities than at the least audible, and no difference is detectible between men and women. Interpretation of the results shows them to be in harmony with Fechner's law, according to which the difference between the sensations due to two lights of the same color or two tones of the same pitch is proportional to the ratio of intensities of the lights or sounds causing the sensations. This simple law holds only at moderate intensities. Phonometric comparisons by a small number of observers were made at intensities from very faint to very loud. It appears that any one ear varies from day to day, but these variations are most noticeable at the extremes of loudness. The results taken all together strongly suggest that, on the average, the relative sensitivity of the ear to different musical notes is practically the same whether the sounds are loud or faint.

Further Tests of Stellar Radiometers and Measurements of Planetary Radiation

THE Bureau of Standards has been conducting for a number of years investigations on the properties of matter, for the purpose of improving the instruments and methods used in measuring thermal radiation. This has led to production of instruments of sufficient sensitivity to measure the heat of stars and planets. The results obtained have opened to astronomers a new field of investigation on the variability of stars, etc.

In Scientific Paper No. 460, obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents a copy, improvements are described in the thermocouples used for measuring the heat from celestial objects and preliminary measurements are given of the heat emitted by the planets, e.g., Mars, Jupiter, Venus, Saturn, etc., as the result of heating by solar radiation.

It is shown that the atmosphere of Mars is only dense enough to intercept a portion of the sun's rays so that the surface of the planet becomes appreciably heated and these emanations may be measured. On the other hand, Jupiter is so far away that its atmosphere is heated but very little by the sun. This atmosphere is so thick and dense that apparently the sun's heat cannot penetrate to the surface of the planet, and even if the planet itself gives out heat, these rays are all trapped by the atmosphere.

When Light Speaks

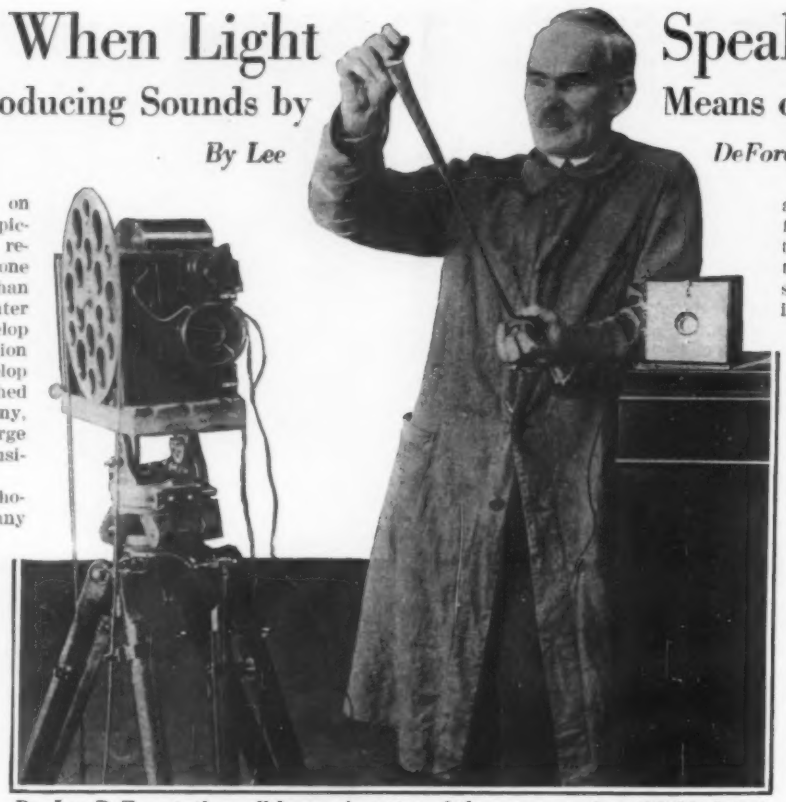
Recording and Reproducing Sounds by Means of Light Intensities

By Lee DeForest, Ph.D.

MY ATTENTION was focused on the field of talking moving pictures wholly by photographic recording in 1918. Perhaps the one consideration which, more than any other, prompted me to enter this field was my desire personally to develop a new and useful application of the audion amplifier—one which I could expect to develop largely by my own efforts as distinguished from its application to long-distance telephony, where obviously the intensive efforts of large corps of engineers, backed by a gigantic business organization, were indispensable.

Another motive was my desire to see a phonographic device which would be free of many of the inherent short-comings of the disc machine, notably the short length of record, the necessity for frequent changings of needles, and the belief that by means of a pencil of light, instead of a steel needle, it might be possible completely to escape from the surface scratch which has always been inseparable from the existing types of phonograph.

Early in the spring of 1919 I filed patent applications on the methods which I believed would accomplish the above laid-down conditions, and began actual research on the various means which might be successfully employed. At that time I figured that the work involved should require at most two years—a period one-half as long as that which has actually been demanded. The work has been almost uninterrupted, and of the most exacting and discouraging nature. Literally hundreds of experiments have been made and thousands of feet of films have been photographed only to be thrown away.



Dr. Lee DeForest, the well-known inventor of the vacuum tube, with his latest invention, the phonofilm "talking picture" camera

The Phonofilm, as its name implies, is the combination on the same film of picture with voice or music photographically recorded. Standard cinematograph film is used. The sound record occupies a very narrow strip of the film about three-thirty-seconds inch wide on the margin, and does not materially reduce the width of the picture.

Phonofilm actual size; sound record at right

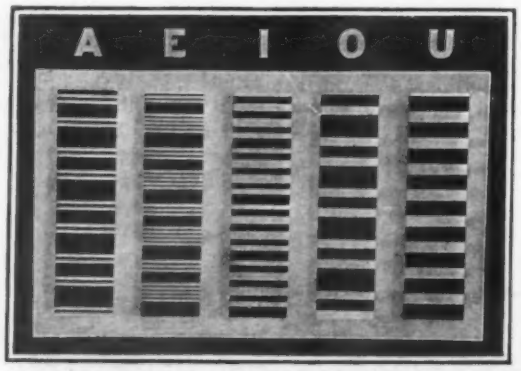
An especially designed gas-filled lamp called the Photion light, is inserted in the moving picture camera a short distance away from the usual objective lens. The light from this Photion tube passes through an extremely narrow slit and falls directly upon one margin of the film. This margin is screened from the picture itself so that only the light from the Photion falls upon it. The film is driven continuously with an even speed, in front of this narrow slit, but with the usual intermittent step-by-step motion in front of the picture aperture.

Now the light in the Photion tube is generated by the electric current which is passing through the gas enclosed therein. The intensity of the light depends on the intensity of the electric current. Therefore, if a powerful telephonic current is passed through the Photion, the light emitted varies exactly in accordance with the strength of the telephonic current at any instant. This light, therefore, fluctuates in brightness hundreds of thousands of times a second in perfect rhythm with the telephonic current pulses, and varies in strength with the current.

This telephonic current originates in the first place from the special microphone transmitter which is quite unlike the ordinary telephonic microphone, but serving the same general purpose. This transmitter picks up the sound waves at distances of five to fifteen feet from the source of sound, transforming these sound waves into very weak telephonic currents. The audion amplifier is then used to amplify these weak currents 100,000 times to bring them up to sufficient strength to influence the Photion lamp in the camera. Without the audion amplifier the entire arrangement would be utterly impractical because of the weakness of the voice currents.

Thus we have three transformations—first, sound waves into electric telephonic currents, then the amplification of these currents into light waves, and the registering of these light waves through the narrow slit upon the photographic film.

The negative film carrying picture and sound record is now developed in the usual manner, but using a special developer to bring out the details of the sound record. Positive prints are made through a special printer to give the necessary light values for pictures and sound record. This positive print is then run through the moving picture projector machine. This is a standard projector machine such as is found in any moving picture theater. A small attachment is added to this projector which in no wise interferes with its ordinary use. This attachment includes a small incandescent lamp and a highly sensitive photo-electric cell, the latter being the invention of T. W. Case. Between the lamp and the photo-electric cell passes the film as it travels through the projector machine. The light from this incandescent lamp is concentrated upon a tiny slit similar to that above described in the motion picture camera. This light therefore passes through the sound record which has been photographed on the film, and on into the chamber containing the photo-electric cell. The passage of the sound record across this narrow slit, therefore, controls the intensity of the light falling upon the sensitive cell.



Sound wave record of vowels, the phonofilm strip being enlarged several times

The photo-electric cell has this peculiar property—its electrical resistance at any instant is determined by the amount of light falling upon the cell. Therefore, as the film travels across the slit and the light falling upon the cell made to fluctuate hundreds or thousands of times per second, the electrical resistance of the cell is varied in strict accordance therewith.

Connected to this photo-electric cell is a small battery for supplying current, which current is therefore controlled by the light falling upon the cell, and thereby made exactly to reproduce the original telephonic current from the transmitter when the sound picture was first recorded. This new telephonic current, however, is extremely weak, and must be amplified, again through a series of especially designed audion amplifiers, until it is increased in power hundreds of thousands of times. This powerful telephonic current then is passed through especially designed loud reproducers which are located behind or alongside of the moving picture screen upon which the picture itself is being thrown from the projector. In this way the reproduced sound appears to come from the voice of the speaker or the musical instrument whose picture is being thrown upon the screen.

By the phonofilm process the problem of synchronism is obviously completely solved. The photograph of the sound and of the object are always together on the same film and always at the same relative positions thereon. If the film breaks it is only necessary to insert a new piece equivalent in length to the part cut away, so that the synchronism is never impaired.

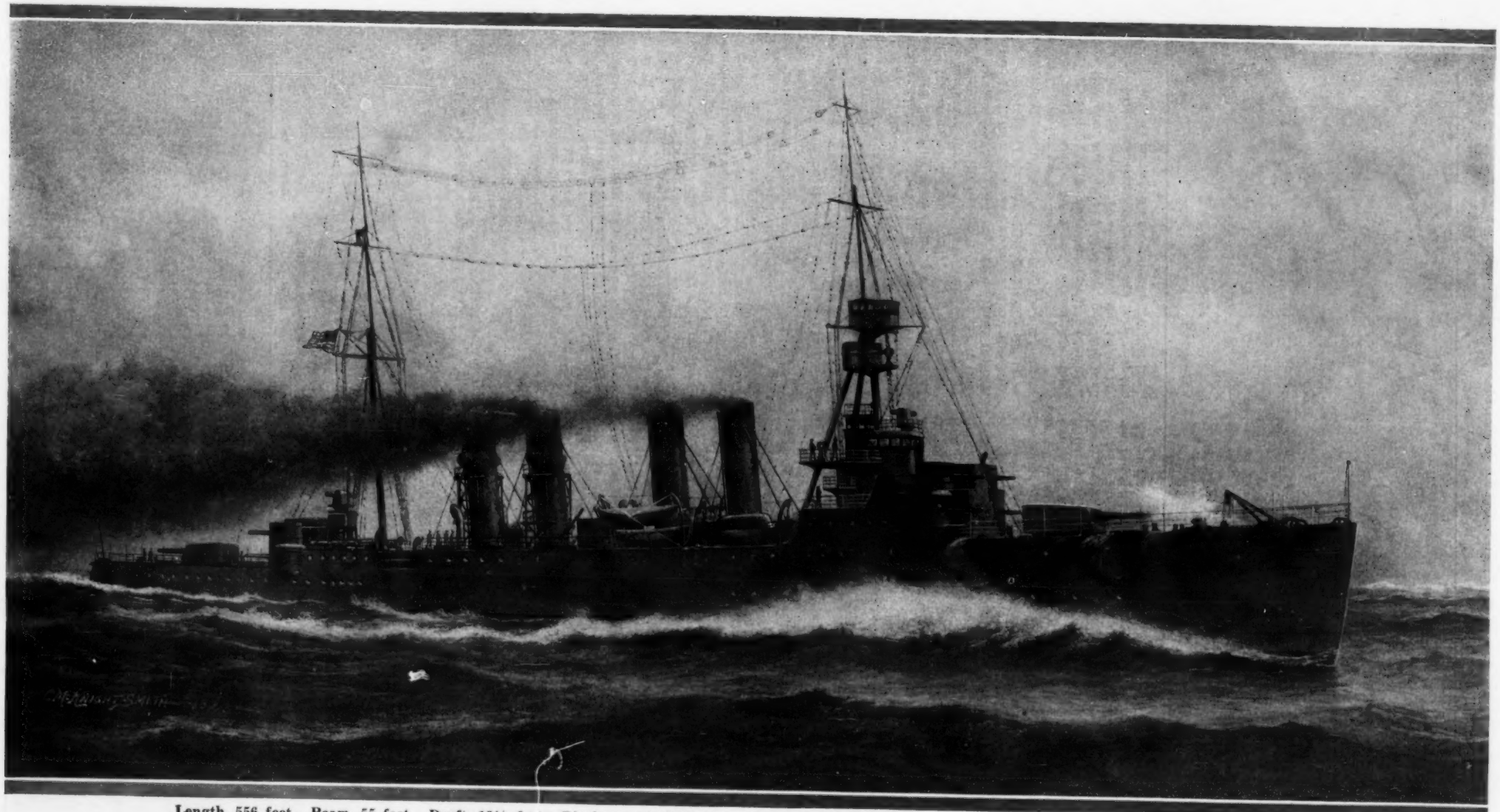
Throughout my work I have had in mind the making of the process thoroughly practical and commercial. Only standard film is used, and the reproducing attachment is designed for attaching to any standard projector.

Spherical Aberration in Thin Lenses

THE images formed by lenses are imperfect, and it is the task of the lens designer to compute lens systems in which the faults in the image shall interfere as little as possible with the uses for which the lens is designed. The requirements for a telescope objective are different from those for a microscope objective while those for a camera lens are still different and vary according to the particular type of work which it is desired to carry out with the lens. Lens designing is really an engineering proposition in which known scientific facts are applied to the solution of a definite problem in construction.

Scientific Paper No. 461 of the Bureau of Standards on the Spherical Aberration of Thin Lenses, for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents a copy, is a contribution to the meager stock of engineering data on the subject of lenses. It presents the data with reference to spherical aberration for a wide range of shapes of lenses for such indices of refraction as are likely to be met in optical designing. These data have been calculated from formulae which are well known, and the data so collected have been applied to the calculation of some of the simpler types of optical systems.

Instructions are given in this publication for calculating without great labor the curves for a telescope lens made from any sort of optical glass. These calculations are carried through for common types of optical glass, and the results are represented in the usual engineering fashion by curves. The paper contains a short discussion of the limitations and possibilities of the method of calculation used, thus furnishing the reader with general ideas of the way in which lenses may be combined for desired results.



Length, 556 feet. Beam, 55 feet. Draft, 13½ feet. Displacement, 7500 tons. Horsepower, 95,000. Maximum speed, 34½ knots. Battery, twelve 6-inch guns

NEW UNITED STATES SCOUT CRUISER "RICHMOND"—FASTEST OF ITS TYPE

THE naval program of 1916 included provisions for the construction of ten Scout Cruisers of 7500 tons displacement with 35 knots speed. They were to be the last word in ships of this class—larger, faster, and more powerfully armed than any others. The urgent call for the construction of destroyers, however, caused the Navy Department to cease the construction of practically the whole of the 1916 program, including the ten scouts. Since the war, the completion of these ships has been carried along as funds were available, and they are now beginning to go into commission.

The "Richmond," built on the Atlantic coast, showed in her recent tests at full power in a run over the measured mile at Rockland, a speed of 34.2 knots, her maximum speed on a single run being 34.48 knots.

An excellent impression of the appearances of these fine vessels is given by the accompanying drawing, which shows the Richmond at full speed in a moderate sea. She is a decidedly handsome craft, and the vessels of her type have frequently been described as enlarged destroyers. As a matter of fact, with a length of 556 feet, a beam of 55 feet, and draft of only 13½ feet, she is as fine, if not finer, than our 35-knot flush-deck destroyers. If we remember rightly, as at first designed, the scouts were even more destroyer-like in appearance than they are today, the forecastle deck ending at the foremast, and the main deck running from that point aft, at the present level of the quarter deck. There was some question as to their girder strength, and we believe the ships were stiffened by continuing the foredeck flush throughout the ship to abaft the mast. This added greatly to the strength and seaworthiness of the craft, but the added weight brought down the speed to a contract speed of 33½ knots.

Steam is raised in 12 water-tube boilers, oil fired, of course, and the power is developed on four shafts, each run by its own independent turbine. At the maximum speed on trial, the "Richmond's" turbines developed 94,000 horsepower. The main armament consists of 12 six-inch rapid fire guns, which are grouped forward of the foremast and aft of the mainmast. On the fore deck, two 6-inch guns are mounted in a twin turret, and just abaft of this are four guns, two on each beam, mounted in sponsons. The six after guns are similarly grouped.

A novelty in this ship, is the adoption of the tripod mast type, which has been well proved for many years in the British Navy. Its advantage is that it is stiffer than the lattice mast, and, therefore, provides a steadier platform for the fire control station, which is carried at the top of the mast.

It is inevitable that 7000 tons equipped with between 90,000 and 100,000 tons horsepower and carrying a heavy battery of twelve, long-caliber, 6-inch guns must be built of comparatively light construction; and it is questionable whether these cruisers are not a little too fine, both in their form and construction, for the extremely trying work of scouting on the high seas and maintaining position in any kind of heavy weather that may be encountered. The war experience and the lessons which it taught seems to call for larger ships with heavier scantling and more rugged construction for this class of work. Therefore, since we are so terribly short of scout cruisers, Congress should provide the navy with 20 larger and heavier scouts, built up to the 10,000 tons limit imposed by the Washington treaty and armed with 8-inch guns. Such ships could keep station far ahead of the fleet, and do so under any possible stress of weather.

Naturally the question will be raised—what shall be done with our ten 7500-ton ships? The answer is to be found in the fact that, while we have the largest and most powerful destroyer fleet of any navy, its efficiency in battle would be greatly hampered by the fact that we have no flotilla leaders; a type which the war showed to be absolutely necessary. Now these scout cruisers would be ideal for such work. Their speed would enable them to lead the destroyers into action and their powerful battery would be very effective in breaking up destroyer attacks, and in meeting and crushing by superior gun fire the largest flotilla leaders of other navies.

The lady beetle | Caterpillar infested with eggs | Digger wasp at its meal | Thread-waisted wasp attacking

Some of the insects that live by preying upon other insects, and the fashion in which they get their food

Insect-Eating Insects

Some Glimpses of the Eternal Struggle for Survival

By Dr. E. Bade

LIFE, which is a continual battle for existence, is fought without regard to rules. The weeds, whose seeds are carried by the fitful winds to the flower beds, fight against the cultivated flowers. They struggle toward the light, and attempt to suppress the desirable flowering plants. Everywhere in this strife of life, the ego, the personal "I," finds expression. The stronger often falls the victim of the weaker through thousands of artifices and ingenious devices, since mother nature is by no means embarrassed in finding new means and ways to arrive at its desired goal. In this respect she is the most prolific inventor, she tries ways which appear harmless enough, but the end is always the same, perpetuation of the species.

The obese caterpillar which sedately eats one leaf after the other, can hardly be distinguished from the surrounding green of the foliage. Suddenly it is frightened from its meal by the appearance of a thread-waisted wasp. The latter flies about it a few times, until it finally alights near by. The caterpillar senses danger, and lifts the anterior part of its body to a position of defense. Nervously the wasp runs about the leaf, the feeders vibrate, the slender abdomen is jerked up and down. Suddenly it lifts itself, hurls itself upon the caterpillar, and grasps it tightly by the neck with its strong mandibles. The poison sting is first placed under the neck of the defenseless larva, and a second sting is placed near the middle of its body, and the caterpillar and the wasp fall to the ground. The caterpillar is not killed by these stings, but it is paralyzed so that it cannot move about freely of its own accord.

The paralyzed prey is then carried by the wasp to some previously dug cave or cavity, and an egg is then deposited on it. When the larva hatches from the egg, it enters its involuntary host at once. Here the fatty parts of the caterpillar are eaten, and when the larva is fully grown and is about to pupate, the vital organs are eaten, and the caterpillar dies.

Other solitary wasps build nests of clay for their young. These are usually found under eaves of houses. Often more than one cell is joined together, and each one is filled with a paralyzed spider, fly, etc., which are eaten alive by the larva. Through the paralysis, the wasp provides its larvæ with a constant supply of fresh meat sufficient to last until they are ready to pupate.

The ichneumon flies (wasps) lay their eggs directly into the body of their prey, and often the eggs of other insects are provided with eggs of these wasps. Nearly every species of butterfly larvæ is preyed upon by certain special species of ichneumon flies. The larger species lay only one egg, of the smaller and smallest species, many hundreds of eggs are often deposited in one caterpillar.

Species of all insect orders fall victims to the rapacity of the ichneumon flies. The Braconidæ infest plant lice.

The ground beetle actually overhauls its victim by the use of "shank's mare"

They deposit an egg in the plant louse, and after a short while its abdomen will have become glassily distended, and it now forms nothing more than a cavity for the wasp which will soon emerge.

The ground beetles, also, are mighty hunters, and they are of considerable economic importance as destroyers of insect pests. As exceptionally rapid runners, they chase and catch smaller beetles, and their murderous propensities lead them to the destruction of snails, centipedes, and others. They are liveliest in the hours of darkness, and when dusk falls they begin their insect hunt. Some run about all day long, while others remain half hidden on the ground between the fallen leaves, waiting for their prey.

The tiny lady-beetles (Coccinella) and their larvæ live almost entirely upon plant lice and scale insects and therefore deserve the most extensive protection. But besides these pests, others are also destroyed, the eggs of the potato-beetle being especially relished.

Beneficial, at least to some extent, are the robber-flies (Asilidæ) with the families Dasyllis, Leptogaster, Erax, and Asilus. The species of Dasyllis resemble the harmless bumble-bees, and this helps them to come close to their unsuspecting prey. On the other hand, it may also protect them from other insect-eating animals.

In general the robber-flies are strong, and dart quickly through the air. Like birds of prey they hurl themselves upon other insects, grasping them by the wing with their front legs, and carrying them to some convenient spot where they can suck out the vital fluid in peace. The beaks of many of these robber-flies are so strong that they can easily penetrate the skin of man, but they do not attack warm-blooded animals. Their prey consists of all kinds of insects; even the larva of butterflies are sometimes, though seldom, taken.

True dragons of the air are the various species of darning-needles. Like birds, they suddenly halt in mid air, hover quietly in the same place, turn quickly about, suddenly shoot vertically in the air, and dart away as if hurled from a gun, so rapid is their motion. In this, their restless flight, all animals which they can conquer, are caught. From out of the dancing mosquito swarms over ponds and streams, many an individual is suddenly carried away and eaten. The bee flies (true flies) and their allies, which visit the flowers, fall their prey. The fluttering butterfly is crunched by the cruel mandibles, and the clumsy, heavily armored, beetle is not safe from attack.

All the smaller insects are caught with the mandibles, the larger prey being caught and held by the feet. These are often torn to pieces while the darning-needle is still in flight, or it carries its prey to some resting place where it is munched at leisure.

The life of all insects in all their stages of development, with the exception of the resting pupa stage, is to eat. These animals can eat an inconceivable quantity of plant material in their short existence, which can be summed up in four words: eating, and being eaten. The profuse insect life is continually being destroyed in order to make life possible for a small minority.

The robber fly and his prey | Dragon fly on the wing | A robber fly that looks like a bumble bee

Three more of the most rapacious of the insects that help to keep down the numbers of the other and weaker species

Immunizing Cabbage by Natural Selection

How Nature's Standard Biological Process Is Adopted and Speeded Up by Man

By Robert G. Skerrett

HAVE YOU ever considered the cabbage as a factor in the American dietary? Have you any idea how prime a part it plays in our annual crops? If you have not, the statistics in the editorial note attached will give you some idea of what the ruin of this crop would mean to American agriculture.

More than twenty years ago the cabbage "patches" of Wisconsin were widely ravaged by a disease known to agriculturists as "cabbage yellows," and the loss ranged from 50 to 95 per cent in fields consisting of highly-fertile soils normally peculiarly suited to cabbage culture. The farmers and the State authorities naturally became much concerned; and steps were taken under the leadership of Dr. L. R. Jones of the University of Wisconsin to determine the genesis of the malady and to find ways to eradicate it or to neutralize its hurtful activities. What has since followed is a fine example of scientific research applied to a relatively lowly problem.

When a cabbage is afflicted with the yellows in its more aggressive form, the vegetable loses vigor, becomes stunted, its foliage assumes a yellow, wilted look, and frequently dies long before reaching the heading stage. The promoting cause of the disease is a soil fungus known to the technicist as Fusarium conglutinans; and a soil so infected is termed "cabbage sick." Once the fungus has been introduced into the soil, it persists indefinitely; and we are told that ordinary crop rotations are of little avail in controlling the disease or in rooting it out. Other vegetables may be planted for a number of years and grow abundantly, and yet when cabbages are tried again the baneful fungus does its destructive work unchecked.

In 1910, the plant pathologists at the university's agricultural experiment station began investigations having for their goal the evolution of control measures. These included divers methods of treating seed, seedlings, and soil, and embraced likewise the testing of disinfectants and fertilizers, but without any encouraging results. Efforts were therefore made to see if a solution of the difficulty did not lie in perpetuating disease-resisting varieties or strains originating right on the infected soil. This was suggested by the fact that even in the "sickest" fields, when autumn came, occasional sound heads were found. Thus taking a cue from nature, profiting by self-developed immunity, the experts carefully selected the most promising of these surviving heads; seed was raised from them; and from this source was grown, in turn, on the worst soil available, an experimental crop. Those plants which remained sound and reached satisfactory maturity were saved as mother-heads for seed.

The consequence of this procedure was the production of Fusarium-resistant cabbages. But the task was by no means confined to propagating just a cabbage which would grow in infected soil and head despite the presence of the menacing fungus; the pathologists had to effect the evolution of types of cabbages suited both for storage, prompt marketing, or conversion into sauerkraut by the numerous factories engaged in this business. This led, first, to experiments with a cabbage of Dutch origin; and this work was brought to a climax when the so-called Wisconsin Hollander was developed possessing both its native merits and a marked capacity to withstand the yellows.

In 1916, field trials were made with the Wisconsin Hollander in competition with a non-resistant commercial cabbage also of the Hollander strain—both strains being planted in sick soils. Taking the average of twenty fields, less than 25 per cent of the Wisconsin Hollander plants showed Fusarium infection, whereas nearly 90 per cent of the commercial Hollander cabbages were afflicted with the yellows. These figures, however, do not tell the whole story. The resistant or Wisconsin Hollander strain was so slightly affected by the disease that even most of those having the yellows carried good-sized heads, while the stricken cabbages of the non-resistant group either died early in the season or formed no heads, if they survived. Another series of experiments, conducted the year following, emphasized further the good work of Dr. Jones and his collaborators. That is to say, there was an average of only 6 per cent of yellows among the resistant or Wisconsin Hollanders whereas about 80 per cent of the commercial strains suffered seriously.

A warm soil encourages the virulence of Fusarium. The summer of 1919 was a hot and dry one, and during that period the relative immunity of the Wisconsin Hollander cabbage was put to a very severe test. Then, even the most resistant of this strain showed some indications of infection, in short, an average of 70 per cent of all of the Wisconsin Hollanders was affected; but as a rule the plants were just moderately diseased, and 80 per cent of the crop lived through the season. The non-resistant "controls" or commercial Hollanders were, without exception, attacked by the yellows, and only one per cent were still alive at harvest time. Today, a strain of the Wisconsin Hollander has been brought into being which has not only the power of resisting Fusarium to a marked degree, but it possesses certain desired physical characteristics, and reaches maturity earlier than the original stock. This strain has descended from a single head selected six years ago.

A similar procedure has been pursued in developing cabbages of other types so that they would be capable of withstanding or resisting the yellows even when grown on sick soil. Dr. Jones and his junior associates have lately reported that: "These resistant strains have proved resistant so far as tested in other States. . . . Our experience gives us confidence that through further selection resistant strains suited to any localized conditions could be secured. It is our belief, therefore, that the cabbage industry can be permanently maintained in any section of the country, insofar as the Fusarium or yellows disease is a limiting factor, through the selection of disease-resistant strains."

However, there seems a natural tendency on the part of cabbages of this sort to revert to the original type unless seed is continually obtained by selection from plants grown on soil impregnated with the troublesome fungus. In other words, the seed for healthy and immune plants should be drawn every now and then from vigorous cabbages raised in fields infested with Fusarium. By this method, so it seems, it will be practicable to maintain the standards so patiently reached after more than a decade of investigation; and thus seed may be successfully produced on any desired scale.

Besides Wisconsin, cabbage growing is carried on intensively in Iowa, Illinois, Indiana, Ohio, Pennsylvania, Maryland, Delaware, New Jersey, and some portions of New York; and the yellows have threatened to do much harm in all of these regions. The work of the agricultural experiment station of the University of Wisconsin has, therefore, a wide field of application. The specific varieties developed in Wisconsin would presumably not be best suited for growth elsewhere; but the Wisconsin method can be applied in other places for the development of varieties suited to local conditions.

The kind of cabbage crop that can be raised when the plants are able to resist an attack of "yellows"

FOR 1920, some 104,850 acres in the United States were planted in cabbage, and 940,525 tons of the vegetable were harvested. At average prices for the year, the value of this crop was $75,000,000. The importance of the cabbage-growing industry is made clearer when it is remembered that there are sections in which this constitutes the principal cash crop; and there are associated industries that stand or fall contingent upon a good cabbage harvest. Such is altogether the case in extensive regions of Wisconsin; and it is upon a situation that arose there, and the methods employed for dealing with it, that Mr. Skerrett writes here.—THE EDITOR.

The Loudest Voiced Bird

WHAT is said to be the loudest voiced bird in the world is the bell bird, which is found in both South America and Africa. The naturalist, Waterton, says of this bird, which is also called the Campanero, "Its song is loud and clear like the note of a bell and is audible at a distance of five kilometers. No song or sound of any other feathered forest dweller rouses so much wonder as the 'tolling' of the Campanero. A single stroke of the bell is heard and these notes follow each other at intervals of about a minute."

The bell bird is pure white in color and about the size of an ordinary pigeon. Its head is adorned (or disfigured) by a singular horny excrescence, which is lifted for a distance about seven centimeters, while the bird is singing. It is this movable horny structure which is connected with the roof of the mouth which provides the resonance which enables the bird to produce its singular bell-like note. Every one who hears its remarkable tone for the first time is convinced that it must proceed from some neighboring church tower or campanile. It is a curious fact that the bird utters its song only when other voices are silent.

Geography and Intelligence

IN a recent address before the Section of Geography of the British Association for the Advancement of Science, Dr. Marion Newbigin discussed the subject of Human Geography: First Principles and Some Applications. Geographers are agreed, Dr. Newbigin said, that there is a definite human geography, but little attention has been given to the problem as to the precise way in which man's response to environmental conditions differs from that of animals. Since man once ran into a number of species—or even of genera—it is obvious that there was once a time when there was no distinctively human response, when adaptation led to specific differentiation, just as it does among animals. But since all living men now belong to one species, it is clear that this time has passed. Its passing appears to be associated with the fact that growing intelligence meant that the barriers of distribution which limit the movements of animals ceased to function.

Obviously, this in its turn might have meant that human evolution had stopped, that man had ceased to be adapted to any particular habitat because fitted for all, were it not that the factors of fixation and isolation, so important in the case of the lower organisms, began to act in a new way. With the growth of cultivation, communities became fixed to particular areas, and if the isolation was sufficient to ensure the necessary continuity and protection during the early stages, a communal as distinct from any individual adaptation appeared. The second part of Dr. Newbigin's address dealt with applications of these general principles to the chief foci of civilization in Europe and the adjacent lands. Thus the causes which promoted the origin, growth, and decay or modification of the successive cultures of the great river valleys, of the Mediterranean seaboard, and of the forest belt of Western Europe were considered, and the peculiar difficulties encountered in establishing stable communities in the steppe lands of Eastern Europe discussed briefly.

Sorting the residue gravel, dumped from the sieve, for diamonds

Diamonds from Guiana

How the Precious Sparklers are Recovered from the Gravel

By Frank Munro

THE ROMANCE of the diamond—fascinating not alone to the devotees of luxury and splendor, but also to the serious and practical man of science, and even to workaday folk—is having some interesting and illuminating chapters added to it by William J. La Varre, an American mineralogist and explorer. He has been down near the equator, to British Guiana—shrouded in its jungle haze; has lighted up that country with the sparkle of its own gems; and has given the hope of wealth, to those, at least, who will intelligently work for it, and take the dare of mosquitoes, malaria and a generally trying climate.

Even the primitive methods of the unskilled natives are yielding large returns; but Mr. La Varre feels that with the introduction of modern ideas and machinery a new El Dorado will be revealed. The promise and potency is in his bringing back to New York, some time ago, a cluster of diamonds of 150 carats; recently he returned with one of 500 carats; also the largest single stone, it is claimed, ever found on this continent, the "Kurupung," of more than 30 carats. Incidentally, it may be said he has gathered specimens of birds and animals for the Smithsonian Institution.

The new region of mineral wealth lies along the Mazaruni River and its tributaries, and is in the jungle about 140 miles from Georgetown, the capital of British Guiana. It has been but scantily prospected by gangs of natives and half-breeds, who have received the name of "pork-knockers," from the fact that their ration consists largely of pig, and they literally beat about the bush. Civilization has laid a very gentle hand upon the people up to the present. Now, apparently, it is about to awaken them with the crackle and crash of the steam-shovel.

Despite industrial deficiencies, these pork-knockers have for some years been shipping small lots of diamonds to England. The men go into the bush in groups or alone, scraping the gravel from the shallow creek beds, or perhaps digging one or two feet into the banks. A happy-go-lucky crowd are they, of Dutch and Indian or Negro lineage. They gather at Bartica, the outermost point of civilization, and wait for a prospecting party that may require extra paddlers. Sometimes they "connect" with a supply boat going to the trading posts in the mining districts. The trip takes several weeks, and is "worked out" by the voyageurs. On leaving the craft they receive a bonus in the shape of a week's supply of pork, rice, salt fish, etc.

The native prospector usually begins his work in a shallow creek bed. The implements consist of an axe, shovel, pick, bucket and a sieve to separate the diamonds from the gravel.

"A party I once chanced upon," says Mr. La Varre, "was illustrative of the average group and method one might see in the bush. A negro (giant in size and clad only in a loin cloth) stood knee-deep in the creek, and with a long-handled shovel filled a bucket with small gravel. The boy who held the bucket carried it to an old man, who did the 'scientific' part of the job; that is, the jigging of the gravel in the round sieve. Diamond production depends largely upon the jigger: if he is careful and knows his work, there will be no loss.

"The old man was astride a pool about three feet wide and two feet deep. By a series of calculated motions he attempted to form a centrifugal force which would serve to center the heaviest material in the bottom of the sieve; and as diamonds are the heaviest of the pebbles, they naturally are the first to respond to the movements. Where diamonds are found there are likely to be also tin, carbon and pulsite, mixed with quartz. These minerals are heaviest, next to diamonds, and are therefore also sent to the bottom.

"The sieve, filled with gravel, was placed in the water and turned from left to right while in a level position. Then it was quickly lowered and raised, and shaken from side to side. Finally it was swung around while tilted. After a few moments the man scooped up the top gravel and threw it away; then he added new gravel to that left in the sieve, and repeated the operation over and over for an hour.

"By this time there was left in the sieve only black carbon, brown pulsite, and a small center of tin, in which the diamonds, if any, were to be found. The sieve was now turned upside down on a piece of level canvas stretched on the ground by means of pegs. From the middle of the outermost residue the prospector picked out a small but perfectly shaped diamond of one-half carat. That stone I have at present as a reminder of the first time I ever saw a gem taken from the soil."

Somewhat in contrast to this, although essentially primitive, has been the procedure at the mine known as Le Desire. It is located in the alluvial deposits in an old bed of the Mazaruni. The river had changed its course since depositing a 60-foot pile of diamond-bearing gravel, and giant trees had grown up. These were cut down, and furnished the beams for the shafts. Here the gravel is washed in "long toms," and several jiggers are employed.

The "toms" are troughs placed at the outlet of a dam in the creek. In each are inserted three sieves of different-sized mesh. The gravel is dumped into the upper end of the trough and washed down by the pressure of the water coming through from the dam above. The larger stones and gravel are kept back and thrown away. After passing through the "long tom," the gravel of uniform size falls into a rectangular flat sieve that is suspended by four chains from a scaffolding in such a way that the pool below just covers the bottom of the sieve. A man stands in this water and shakes the container. This gives the finishing touches to the washing. Then the gravel is brought to workers who "jig" it in large square boxes.

Diamonds are easily identified in the raw state by their peculiar sheen and shape; but if there is any doubt about the stones, the matter can be decided by subjecting them to pressure between two knives. Almost anything except a diamond can be crushed. In color they vary from white to pink, blue, yellow, green, and black. Their shapes range from spherical to flat. Some "raw" stones from the Mazaruni region are so perfect in shape and color that it is difficult to believe they have not been cut and polished by machinery.

The supposition is that the diamonds which are found in the creek beds are the alluvial deposits of a primary formation; that is, they come directly to the stream gravels from the breaking-up and erosion of the rock in which they were formed. Alternate changes in temperature (heat by day, chill by night) will sometimes accomplish this, the mass having received an initial impulse or direction. All this means easier mining and a quicker tracing of the source. The shape, and the markings on the Kurupung already referred to, give evidence of its history: an eighth of an inch groove on one octohedral face could only have been caused by the continuous rubbing of loose material across that side when it became exposed on the surface of the rock in which it lay firmly imbedded.

When Mr. La Varre, on one of his earlier trips of exploration, visited the Mazaruni region he found that the natives, ignorant of the true value of these alluvial diamonds, were using them frequently for such household aids as potato-scrapers! Now the bort, or chips, find their way largely to British manufacturing plants, where highly polished surfaces of steel are required.

The one thing the native prospector has lost sight of is the fact that diamonds come from central sources, and that creeks in which they are found lead to those sources. It is hard to push on when one finds that gems lie beneath one's feet; but if one is to reach the real treasure one needs to go ahead. With little capital and few provisions, the natives are not able to let the small stuff go, and so miss the big. It is the white man's opportunity. Taking the best skill and science to the Mazaruni region, what may not be looked for?

The "long Tom" in action, washing gravel and sorting out large stuff preparatory to jigging

Entrance to a diamond mine, showing piles of washed and sorted gravel

Dayton's latest landing signal for the night-flying pilot

A Beacon for Aviators

A MOTOR truck whose engine supplies electric current for lighting a powerful searchlight, in the form of a beacon for guiding aviators when flying at night, was recently demonstrated at McCook Field, Dayton, Ohio. The same engine that furnishes motive power for the operation of the motorized vehicle also is the source of current for illuminating the brilliant searchlight.

The light radiated by this new type of beacon is of high intensity—300,000,000 candlepower—and the reflector for spreading the rays of light measures thirty-six inches in diameter. By the illumination radiated from this powerful searchlight, when stationed at a landing field, the aviator when navigating the air after nightfall should be enabled to locate the landing field from a distance of 75 to 100 miles. Similar beacons are employed on battleships when at sea, but this is the first time that such a searchlight has been adapted to purposes afield.

When the United States Post Office Department is contemplating the innovation of the carriage of postal matter by aircraft at night the necessity of marking landing fields by some form of artificial illumination is apparent. The location of powerful beacons at intervals of 100 miles along the route over which the mails are to be transported is the most common suggestion as a way of solving the problem of night-flying of airplanes. Then, too, the navigation of air-going machines after nightfall is becoming more common for general purposes as aircraft development seeks a foothold in America. Some system of marking the landing fields by searchlights will have to be devised, if night-flying is to become a practice, and the beacon illustrated is a long step in the right direction.

The Gipsy Moth and Dead Trees

THE gipsy moth has now spread over a large part of New England and is in position to continue its march over the adjacent states, and the rest of the land. During the past two years it has moved westward, fifty miles. At the rate of 25 miles per year, the death of our trees, especially the oaks, can be predicted by arithmetic unless help arrives in time. To combat this threat the Federal Government has been spending about $150,000 per year, but this has only retarded the spread of the moth. Those who have seen the chestnut trees in the East standing out in the forests like gaunt, stark skeletons as the result of another destructive agency which rapidly spread over whole states, will best be able to envision the oaks, a more numerous species, silhouetted against a mass of green, dead. On Cape Cod, where the moth has been active, 90 per cent of the oaks are dying.

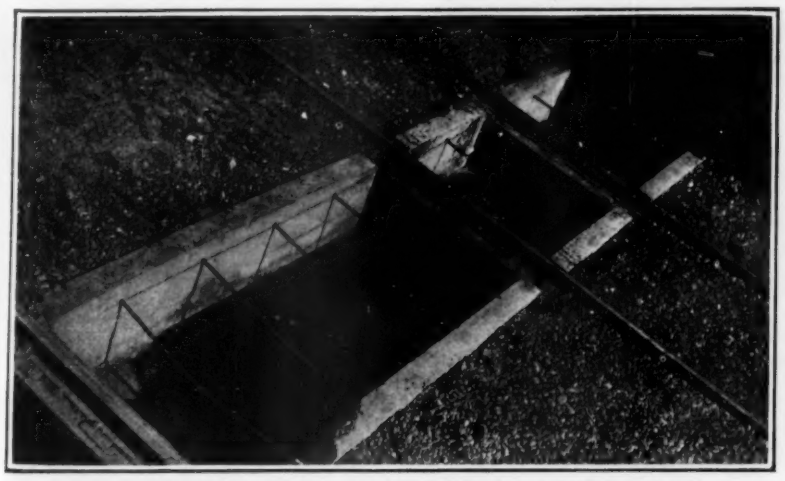
As the pest spreads, it will be the turn of the New York State oaks to die next, unless something is done, for the moth has already established itself along 75 miles of the eastern border of that state. Stopping the moth is like stopping the spread of a grass fire in a strong wind: if begun in time it can be done. If not, it must burn itself out. The fire spreads from all sides of the circle, but the fire-fighter can work from only one place.

Pursuing this analogy, it has been proposed to establish a barrier zone from Long Island Sound to Canada, having a width of 25 miles, beyond which the Gipsy Moth shall not be allowed to establish itself. This really amounts to applying the same exterminating measures to a narrow strip as would be otherwise necessary to apply to the entire area infested.

Owing to the prohibitive cost of establishing control of the moth in the forests, except in a limited belt as a protective or defensive strip, it is nearly impossible to grow many of the most valuable trees to timber size in badly infested areas. Therefore these may produce little else than scrub and brush. A failure to recognize the possibilities of a barrier zone, and to provide means for combatting the ruinous pest within its limits may expose a large proportion of the country to the ravages of an extremely injurious forest insect just at a time when every effort should be made to conserve and increase our forests and forest products. Within such a limited area, it is merely a matter of concerted effort, by burning, spraying, etc., to suppress the moth entirely.

An Effective Barrier for Automobiles

SAN FRANCISCO, the city of high hills and terrific grades, has solved the problem of getting the trolleys across one of the stiffest of these eminences, Twin Peaks, by boring a tunnel beneath the ridge. This tunnel is intended only for the trolleys; but its entrance is so situated with respect to the automobile road that numerous automobilists have, in perfectly good faith, attempted its passage—aside from those who, in bad faith, have preferred going through to going over. Unfortunately, there is not clearance for a car and an automobile in the tunnel, and the chauffeur who meets a trolley half-way through has to back out, to everybody's great inconvenience. The trolley company finally hit upon a novel expedient for keeping the intruding automobile out of the tunnel—the concrete ditch shown in the picture at the lower left corner of the page. The ditch is three feet wide, and, with the trolley rail of upstanding T-form, its negotiation by a car or truck would be quite out of the question, and no chauffeur would attempt it.



The concrete ditch that keeps automobiles out of San Francisco's trolley tunnel

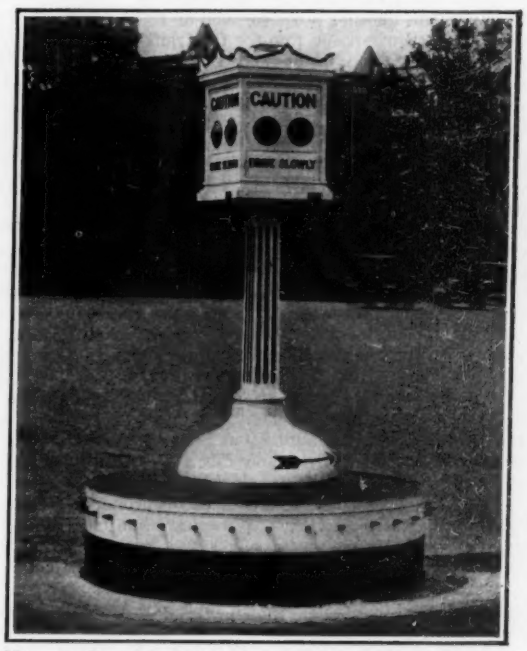
The mirror that gives the motorman a last look at his trolley wheel before entering the tunnel

A Mirror in a Novel Place

THE ingenuity of San Francisco's tunnel builders did not stop with the automobile bar described in the preceding column. The tunnel is dark, and it would be extremely difficult to replace the trolley wheel on the wire, if it should come off. In the straight run through the tunnel the possibility of its coming off is slight; but in crossing the connections at the mouth of the shaft this possibility is fairly large. So the little mirror illustrated has been installed, and the motorman is expected to assure himself that the trolley wheel is properly seated before he enters the bore.

The Talking Traffic Lamp

AUTOMOBILISTS whose driving takes them into the surburban towns of New Jersey have been treated during the past few months to a new model of traffic signal which they have found to give admirable service. The idea behind this new signal is twofold. First, it uses flashing colored lights to attract the driver's attention, rather than a fixed light. These flashing lights can be seen for a mile or more when the configuration of the road permits, and hence the driver has ample warning of the danger spot. Second, when he reaches the signal, he is left in no doubt as to what he should do, what the local police regulations demand that he do, etc. At a sufficient distance from the signal to obviate the necessity of stopping to make them out, he finds that the lamp or the post or the base carries full instructions—words, arrows, or whatever else be necessary. These lamps are being installed in increasing numbers at danger points and traffic centers. In the latter instance, street names and destination signs take the place of the arrow and the admonitory lettering. Both by day and by night the motorist can read all this as he approaches, without stopping.



New traffic signal that is easy to find and easier to read

Carrier Current Telephony

Guiding Radio Telephony over Existing Telegraph, Telephone or Power Lines

By B. R. Cummings
Radio Engineer of General Electric Company

IT IS a matter of common knowledge that a single electrical conductor can be made to be a part of two or more electrical circuits and function in each circuit simultaneously. It is possible, for example, for a single conductor to carry both alternating and direct current, or two or more alternating currents of different frequency characteristics, simultaneously.

These currents do not exist independently in the conductor, however, and at any instant the current flowing is the sum of all component currents.

While the current in the conductor is the resultant of individual currents, it is possible to attach to such conductors suitable groups of apparatus, so that one group will respond to the current of one characteristic, and the other to that of the other characteristic.

This fact is somewhat analogous to transmission by radio at different wavelengths. The ether, which is the medium which conveys radio signals, is carrying a very great number of independent communications simultaneously, although we are able to adjust our radio receivers so that we can select signals at one frequency, and, with sufficient frequency separation, hear nothing that is being transmitted at other frequencies.

So that, while signals carried by wire are transmitted by conduction rather than by radiation, a conductor may be made the medium whereby a great number of signals, having individual characteristics, are carried simultaneously, and each can be received by apparatus which is adjusted to select any of the incoming signals.

This phenomenon has found growing application in communication systems. For example, if a group of wire lines between two points are being used for telephone communication to their capacity, additional communication can be provided between these points either by erecting new lines, or by making the existing conductors carry additional load of characteristics differing sufficiently from those of the existing load to permit its independent reception. The choice between the two methods becomes a question of economic selection.

Similarly, if communication is desired between two points already connected by lines used for another purpose, such as for example, a transmission line for the transmission of power, it is possible to utilize these lines for telephone communication, rather than erect an independent line for this purpose.

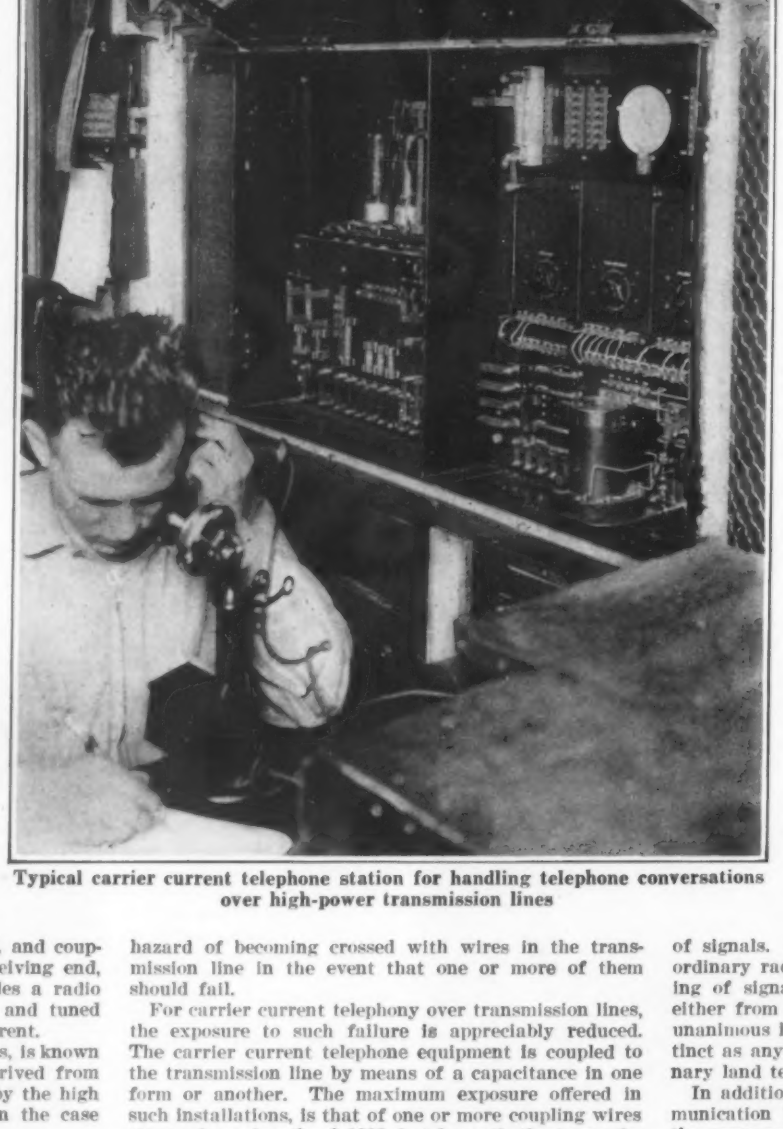
The method used to superimpose telephone communication on a line already in use for the transmission of speech by the usual methods, or for the transmission of power, lies in generating an alternating current of rather high frequency, modulating it in much the same manner as the output of a radio transmitter is modulated, and coupling the generator to the line. At the receiving end, apparatus is used which somewhat resembles a radio receiver. This is also coupled to the line, and tuned to the frequency of the communication current.

The system of communication which results, is known as "Carrier Current Telephony," a name derived from the fact that the communication is carried by the high frequency source rather than directly, as in the case of the usual telephone line.

Since radiation is almost directly proportional to frequency, and since the frequencies used for carrier current work are comparatively low, a line utilized for carrier current communication radiates very little energy, and communication is carried on primarily by conduction. Such transmission, therefore, is fundamentally different from transmission by radio.

Carrier current communication has advantages over wire telephony in addition to the fundamental in that it can be applied to existing lines. For example, it is customary for power companies who maintain long transmission lines, to provide for telephone communication between their various stations and sub-stations, by running wires either above or below the power lines. Such procedure, while undoubtedly serving its purpose to a certain extent, is subject to failure from a number of sources.

For example, the entire line from one station to the other must be maintained intact for communication to be maintained. The fact that the line is exposed to damage for a great many miles makes it probable that it will be brought down by severe wind or hail storms, putting the telephone service out of commission. The fact that it runs this distance also exposes it to the hazard of becoming crossed with wires in the transmission line in the event that one or more of them should fail.



Typical carrier current telephone station for handling telephone conversations over high-power transmission lines

For carrier current telephony over transmission lines, the exposure to such failure is appreciably reduced. The carrier current telephone equipment is coupled to the transmission line by means of a capacitance in one form or another. The maximum exposure offered in such installations, is that of one or more coupling wires strung for a length of 1000 feet beneath the transmission line. This is necessary at both the transmitting and receiving station. The physical exposure, therefore, is reduced to a negligible minimum when compared to the total length of the line. The reduced exposure of the carrier system also results in its far greater freedom from disturbances which are usually encountered in telephone lines erected adjacent to transmission lines. This refers to induced noises, lightning and atmospheric disturbances.

While carrier current telephony requires, for successful operation, a closed alternating current circuit, such a circuit may be maintained under conditions which would be fatal to a direct current circuit. For example, one or more of the conductors of a transmission line may be severed without destroying communication, since the alternating current circuit remains intact so long as there is a single conductor left intact, or so long as any opening in the line has sufficient capacity associated with it to keep the alternating current circuit intact.

Carrier current telephony, however, will not be successful on a system if the line is completely opened either by switches or by all of the conductors in the system becoming severed, unless additional so-called "coupling equipment" is provided for bridging the point at which the circuit is opened. This provision is most applicable at points where the circuit is intentionally opened at intervals such as at switching stations or at circuit breakers.

If communication is required by the two points under the most severe conditions, such as the complete transmission line being down for a considerable distance, straight radio is the only sure solution. One of the greatest advantages of carrier current telephony, however, lies in the fact that it is not radio equipment and the stations are not radio stations and that, therefore, it is not necessary to obtain an operating license from the Department of Commerce and keep an operator on watch at all times.

Carrier current telephony on power lines can best be justified when the system is erected. If carrier current is used, no provision need be made for the erection of telephone lines. Since such provision is a matter of considerable cost, particularly in cases where provision for a telephone line would mean the erection of towers several feet higher than would otherwise be required, it is far more economical to install a carrier current communication system.

Successful tests of carrier current, as a means of communication between moving street cars and the power station on the Third Avenue Railway of New York City, were recently completed. This is the first time that a moving trolley car has been able to keep in constant communication with headquarters and marks a new advent in this new science.

At the suggestion of the Third Avenue Railway, this new use of carrier current was tried. A transmitting and receiving set, similar to that used in any radio broadcasting station, was installed in the Brook Avenue sub-station in the Bronx and a similar set was installed in one of the street cars. The messages, as broadcast from either the car or the sub-station, instead of flying in all directions through space, were confined to the trolley wire, thus insuring privacy and direction of signals. Other advantages of carrier current over ordinary radio were the absence of static and the fading of signals. Persons who listened in and talked, either from the moving car or the power station, were unanimous in declaring the voice was as clear and distinct as any conversation they had heard over an ordinary land telephone.

In addition to being a means for instantaneous communication between headquarters and a trolley car, the same apparatus can be installed on an emergency or repair wagon. Then when this wagon is sent out on some trouble, by merely connecting the lead from the carrier current set to the trolley whether there is power in the wire or not, the workmen can be kept in constant touch with the repair barn. So as not to be dependent on trolley current, the telephone set is operated from storage batteries, which in turn operate a motor generator set, thus supplying the necessary

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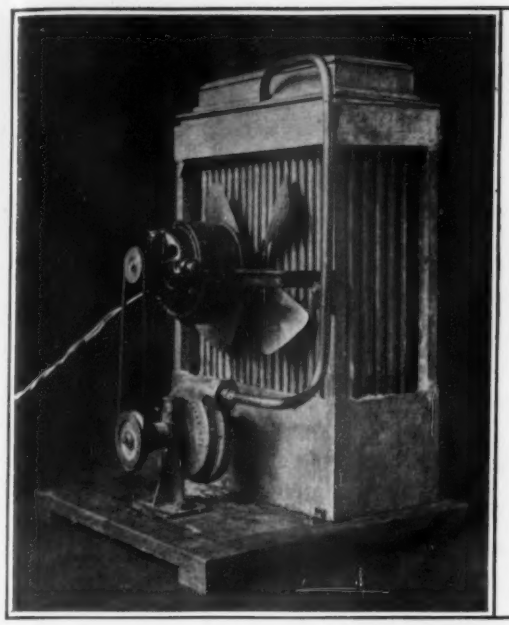
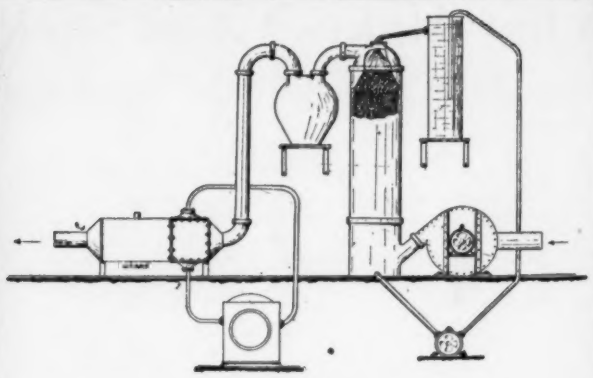
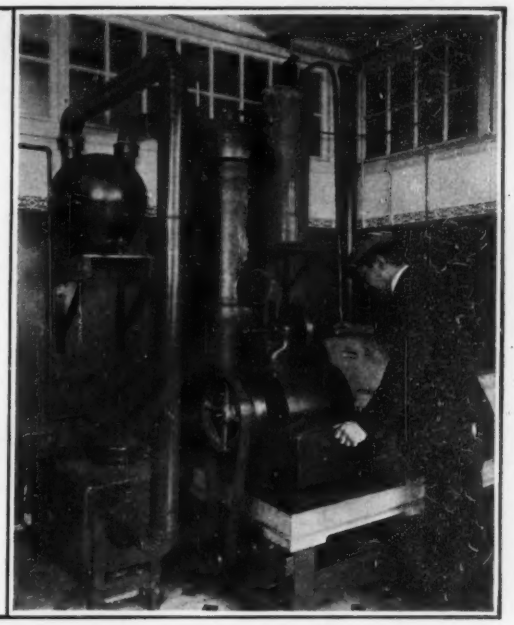






Left: Portable style of the apparatus that gives adequate ventilation in the absence of any new air. *Center:* Diagram showing the modus operandi. The foul air enters at the right, as indicated by the arrow, passes through the washing tower and chemical cleaner, and issues forth in a clean and fresh state at the left, as indicated by arrow. *Right:* The outfit in stationary model for ventilating a chemical factory

How a Berlin doctor has made it possible to have clean, breathable air under all conditions

Making Old Air Better Than New

By Dr. A. Gradenwitz

WHATEVER the organism produces by its normal respiration and perspiration, carbonic acid and water vapor, mixed with morbid germs and the dust raised by a multitude of operations and made all the more offensive by an often uncomfortable rise in temperature; whatever industrial processes turn out in the way of unhygienic dust and bad odors; all call for a periodical renewal of air. Now, what can the "fresh" air derived from inhabitated areas, especially in densely populated cities, be expected to yield for ventilation purposes, filled as it is with similar impurities in addition to the dust and smell left by passers-by and vehicular traffic? Still, for want of better, we had so far to be satisfied with this outside air, both in opening our windows for the sake of ventilation and in connection with those ventilation plants admirable from other points of view.

A medical practitioner living in Berlin, Dr. Albert Wolff, has devised a remarkable new scheme enabling the air in a closed room, within a minimum of time, to be perfectly regenerated, eliminating even the most offensive odors, any trace of dust and morbid germs, disposing of any surplus carbonic acid and water vapor, as well as lowering its temperature in summer and raising it in winter—all without any supply of outside air. The process has now been developed to a commercial stage and, but for economical conditions at present prevailing in Germany, would long have been in operation on a large scale.

The process consists of three consecutive stages, the first of which is optional, the remaining two compulsory. Whenever, in fact, dust of an especially coarse description is raised in the rooms to be ventilated, an incombustible mechanical filter should preferably be inserted in front of the apparatus, thus reducing its wear and tear. This, of course, is quite independent of the process proper, the underlying principle of which can be stated as follows:

The air to be regenerated is, by a combination of specially designed pumps with a washing process, whirled around into minute bubbles, so as to appear like smoke or mist, in the water of a washing tower. After being thus spread over an area as great as possible, the air, in the third stage, comes into contact with an electro-colloidal solution, automatically supplied from a regenerating reservoir, and which exerts on all oxidizable matter an extremely energetic oxidation effect. The apparatus is placed in an adjoining room and draws the air in from the ceiling. The admission of air takes place at the floor, care being taken to avoid any draught in spite of a tenfold exchange of air per hour and heavy differences in temperature between the admission and escape openings.

The oxidizing solution is obtained by the action of ozone on metallic chlorides. The reagent, after escaping from the lower part of the washing tower, is automatically regenerated in a continuous cycle, so as to be used over again. Any possibility of free ozones entering the ventilation air and thus irritating the organs of respiration is absolutely excluded. The air escaping from the top of the washing tower passes through a drop-catcher and across heaters, enabling its temperature and moisture to be adjusted at will.

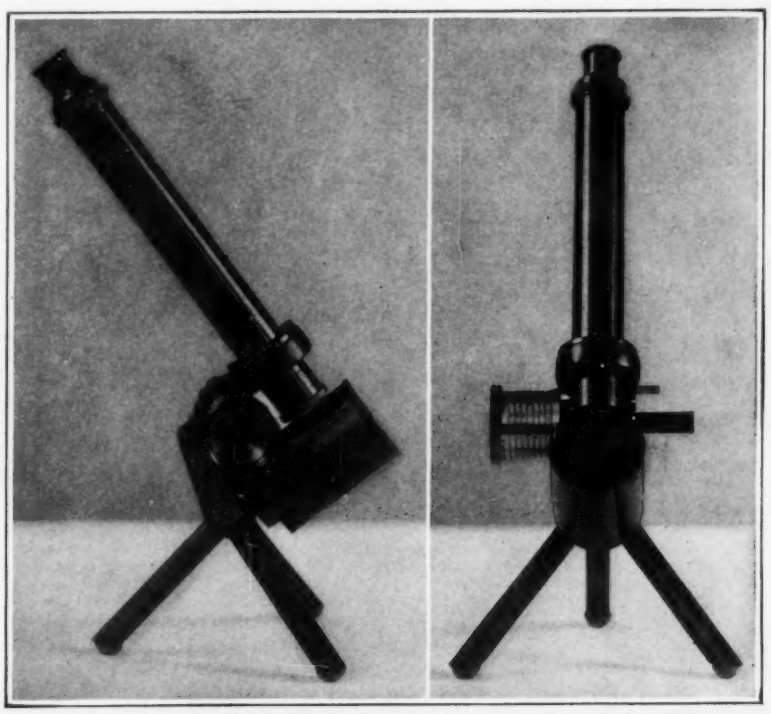
The whole of the oxidizable matter is submitted in the washing tower to the continuous action of nascent oxygen. The most offensive odors are totally absorbed by the apparatus. Morbid germs from the bucal cavity, according to tests made at the principal Berlin hospitals, are annihilated completely. The most remarkable feature in this connection is that on account of the instantaneous destruction the apparatus always is sterile and never, like other filters, becomes a focus of infection.

The carbonic acid of the entering air is, by a special chemical process connected with the filling material, reduced by degrees. An apparatus dealing with about 300 cubic meters per hour takes up a space of about two cubic meters and requires an expenditure of about three kilowatts per hour for its operation, inclusive of the cooling effect.

The very finest dust particles suspended in the air and on which all filters so far in use had been without any effect can thus be disposed of. The process will prove especially invaluable in the case of industrial plants the operation of which is connected with the production of offensive smells. Refrigerating chambers will derive great profit from its use, while the air in hospitals can by means of the new process be controlled at will, so as to contain only disinfected air and medicine. During the war, use has already been made of the process for the aseptic treatment of wounds without any dressing in Berlin military hospitals. If economic conditions at present prevail'ng allowed of the expense, it would be possible with ut any trace of draught to ventilate hospital wards with an individual atmosphere corresponding to any special conditions.

An additional advantage is that, wherever required, any valuable material can readily be recovered from the air thus treated. This possibility has already been made use of in the chemical industry.

This German device presents an interesting development in ventilation problems. Heretofore, the usual idea has been to expel foul air and take in fresh—or so-called fresh—air from outdoors. There have also been devices for producing ozone for the purpose of destroying bacteria in the foul air, but, as pointed out, this pungent gas irritates the lungs. In crowded districts the problem of good air is a pressing one.



Recently developed "spectrometer" for applying the principles of spectroscopy to commercial analysis

Chemical Analysis With the Spectroscope

SEPARATION by ordinary means of sufficient quantity of an impurity to determine its nature is often a lengthy process. With a spectrometer, on the other hand, the presence of spectral lines characteristic of a given impurity may be detected at once. In many cases as little as one part in 100,000 can be observed instantaneously and without error. In some cases, quantitative determination is even possible, the time required for the disappearance of the line in the arc being a measure of the amount of the impurity present.

Improved apparatus for such determinations as these is recently on the market. It is similar in appearance and size to a microscope, as our views show, and takes no more room on the table. The telescope has in its eyepiece a slit and a small autocollimating prism for introducing the light. After passing through the object glass the rays of light proceed to the 30-degree prism. This is silvered on its back surface, and the light retraces its path through the object glass to the eyepiece by means of which the spectrum is viewed. The prism is mounted on a table provided with a lever, and is rotated by means of a micrometer screw pressing against the lever, to which screw is attached a drum, on which is engraved the scale of wave-lengths. The index moves along a helical slot.

What Makes Glue Stick?

Some Studies of the Roles Played by the Wood and by the Adhesive

By Eloise Gerry and T. R. Truax

Of the staff of the Forest Products Laboratory, Madison, Wis.

WOOD, because of its cellular structure, can be glued more easily than many other materials, such as glass or metals. The adhesive is forced into the hollow air spaces, the cell cavities or the pores of the wood, where it becomes firmly anchored. When a good glue has become set, it is possible to shear or tear apart the solid wood without breaking the glue joint.

The accompanying pictures of plywood, as seen under the microscope, illustrate the appearance of some veneers glued together with the grain of alternate plies running at right angles to each other. The manner in which the glue enters woods with different types of structure is shown.

The material here presented was obtained in the course of investigations now being carried on at the United States Forest Products Laboratory to determine the effect of various isolated factors, such as wood structure, pressure, length of assembling period, moisture content, and temperature of the wood, upon the results secured in gluing different species of wood with different kinds of glues.

Glues which are commonly used as adhesives for wood may be classed as (1) animal and fish glue, (2) vegetable glue, (3) casein glue, and (4) blood albumen glue. For a comparison of different glues as to manufacture, properties, and uses see Report No. 66 of the National Advisory Committee for Aeronautics, entitled "Glues Used in Airplane Parts," by S. W. Allen and T. R. Truax.

In all the woods examined it was found that the various glues did not penetrate the cell walls but entered only the exposed openings of the cell cavities. As is evident in one photograph, where two pieces of veneer are glued at right angles, the manner in which the glue penetrates is chiefly due to the fact that the veneers were cut in such a way that a very slight cross grain (as it appears under the microscope) is present. This permits the glue to penetrate the wood through the cell openings thus exposed (*A*, in the photograph) which extend away from the spread surface at a slight angle. If the cross grain is pronounced, however, it weakens the veneer and also tends to permit the glue to penetrate to the outer surface of the panel and produce undesirable staining. At *B*, on the picture, is shown the penetration as it appears on the end grain. From this it is apparent that the diagonal penetration of the glue may extend some depth below the spread surface. Were the manner of its entrance not realized, the appearance of the penetrated pores at *B* might mislead one into thinking that the glue had penetrated directly through the cell walls from the spread surface, instead of only through cavities, which at some point are in contact with the spread surface, as *A* to *C* in the left view of the bottom group.

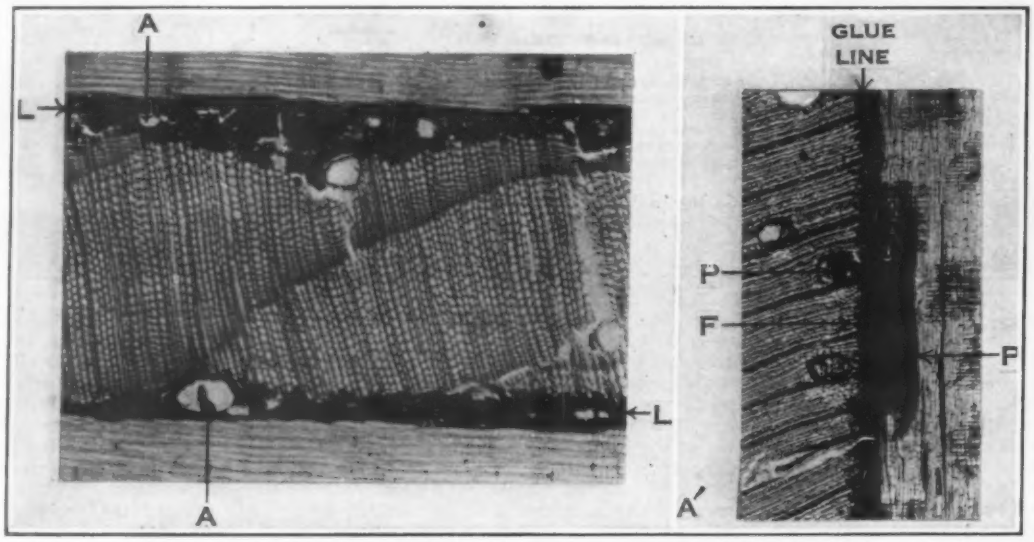
Provided a continuous film of glue is present, and sufficient penetration is obtained, the thickness of the glue line in the joint may vary considerably without appreciably affecting the strength of the union. This is illustrated by the fourth and fifth views, showing joints of substantially equal strength. On the other hand, air pockets (*A*, in the first view) or undue forcing of the glue out of the joint may materially weaken the panel. It is not necessary that the glue penetrate for a long distance into the wood, if only a sufficient anchorage is obtained all the way along the joint surfaces. Numerous relatively shallow glue pockets, such as are made by the penetrated fibers at *F*, in our last photograph, are preferable to a few deeply penetrated, but isolated, cells.

Relatively large cavities, such as those of the pores or vessels of hardwoods, as in red oak, mahogany, or birch, are penetrated with considerable ease, especially when they are not closed by tyloses or gums. Hence, for the most part, when abundant pores are present, the longitudinal surfaces of relatively coarse-textured woods can be glued very readily. In joining end-grain surfaces, on the other hand, large, open pores tend to absorb too much glue and cause a starved joint, unless special precautions are taken. The evenness of the distribution and the abundance of the pores, especially on longitudinal surfaces, are very significant factors in successful gluing.

From a standpoint of the number and distribution of pores, it is obvious that with the same treatment basswood could be glued more easily than oak, where surfaces practically lacking in pores, may occur. If the pores were the only means for holding the glue, Spanish cedar and black walnut would be found relatively difficult to glue. The general penetration of the fibers, *F*, in our second view, is a significant factor in such woods, however, and is to some extent necessary if a strong joint is to be obtained.

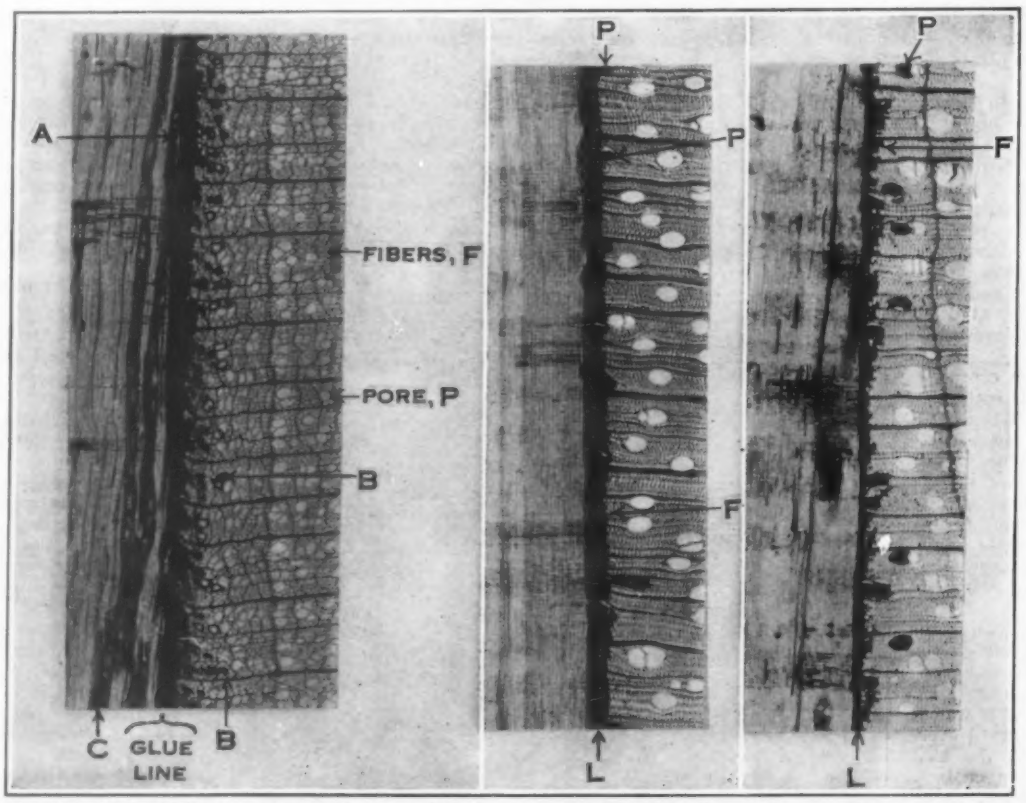
Woods having fine texture, or a large proportion of cells with small cavities, may require different treatment, especially with glues of relatively high viscosity. The fibers of white oak, hickory, black walnut, and ash, are examples of wood structure where special attention is usually necessary in order to force the glue into the smaller cavities. Our fourth and fifth figures afford a comparison of the penetration occurring in the fine-textured portion, made up chiefly of the fibers *F*, in birch under different pressures. In this case, however, the additional penetration of the fibers seemed to be unnecessary, since the anchorage of the glue in the numerous pores made a joint practically as strong as the wood. In contrast to the numerous pores of birch.

(*Continued on page 142*)



Left: Three-ply soft pine glued with blood albumen glue. Only enough pressure was applied to keep the veneers in contact. Note the wide glue lines, *L*, and air pocket, *A*. *Right:* Spanish cedar glued with blood albumen glue. There are few pores, *P*, and they are rather isolated. Penetration of the fibers, *F*, therefore greatly strengthens the joint

Typical glued joints of different characteristics



Left: Blood glue joint between basswood veneers. The glue has penetrated chiefly through the pores, *P*, openings larger than those of the surrounding fibers, *F*. This is a typical wood of easy penetration. *Center:* Birch glued with blood albumen glue under pressure of 50 pounds per square inch. Note wide glue line, *L*; penetration is chiefly in the pores, *P*, with little in the fibers, *F*. *Right:* Same combination, but glued under 200-pound pressure. Here we have a narrow glue line, with good penetration in fibers as well as pores

Some more details of glue penetration under different conditions

Solders for Aluminum

CIRCULAR No. 78 of the Bureau of Standards entitled "Solders for Aluminum" has recently been revised. It will soon be available from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy.

Most of the metals commonly used in solders, except magnesium, are electro-positive to aluminum, so that any metals used in making a soldered joint of aluminum act electrolytically in the presence of moisture as positive galvanic poles accelerating the corrosion of the aluminum. Magnesium cannot be utilized advantageously even though it is electro-negative to aluminum because the metal disintegrates rapidly in the presence of moisture. Therefore, soldered joints of aluminum which are to be exposed to moisture should be protected against corrosion by paint or varnish. Various compositions of zinc-tin and zinc-tin-aluminum solders give the best results.

The tensile strength of a good aluminum solder is about 7000 pounds per square inch, because those with higher tensile strength usually have such a high temperature of complete liquidation that they are unsuited for soldering. Usually the strength of an aluminum soldered joint depends upon the type and workmanship.

A Draw Bridge Which Slides Diagonally

THERE is something decidedly different about the draw bridge shown in the accompanying illustration, even though it has been in use for several decades. Because of the limited space available, this bridge, which spans the Bronx River in New York City, has had to be designed along somewhat unorthodox lines. It is mounted on flanged wheels which ride on rails laid diagonally to the line of the bridge. When the bridge is to be opened for river traffic, the bridge attendant pulls the bridge along the diagonal rails by means of a windlass. Hence the bridge moves to a position parallel to, but a short distance inshore from its usual location by this diagonal movement.

Copyright, Keystone View Co.

This bridge moves out of the way for passing river traffic by sliding diagonally on the rails shown

Putting Out Oil Tank Fires With Water

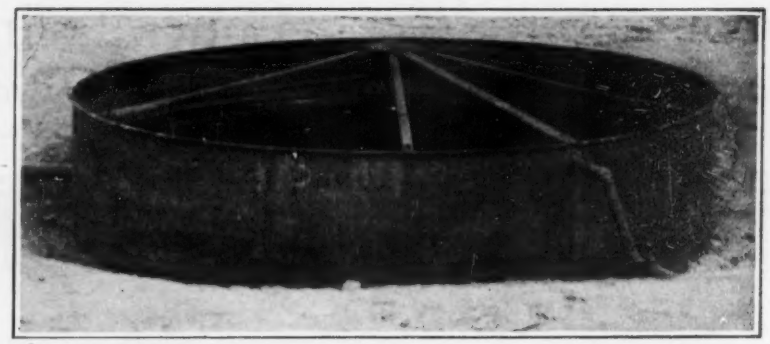
THE application of water in the extinguishing of oil tank fires was successfully demonstrated in San Francisco recently before representatives of various oil companies. The demonstrations were given near one of the municipal fire engine houses, where a tank 20 feet in diameter and 4 feet high, and a tank 12 feet in diameter and 4 feet high, were installed, both tanks being connected with a centrifugal pump having a capacity of 500 gallons of water per minute at a discharge head of 100 pounds per square inch. The pump was directly connected to a 50-horsepower electric motor.

The 20-foot tank has 1½-inch lines each 7 feet 6 inches long, radiating from the center of the tank to separate individual water distributors spaced equidistant circumferentially. During one of the demonstrations 12 inches of oil or 850 gallons was used in the 12-foot tank and allowed to burn until the fire was going strong, the fire being extinguished in five seconds with 25 gallons of water. The fire was actually out in less than five seconds; in fact, almost immediately on the application of the water curtain which is produced by the water distributors, the latter spreading an unbroken curtain of water over and above the surface of the burning oil.

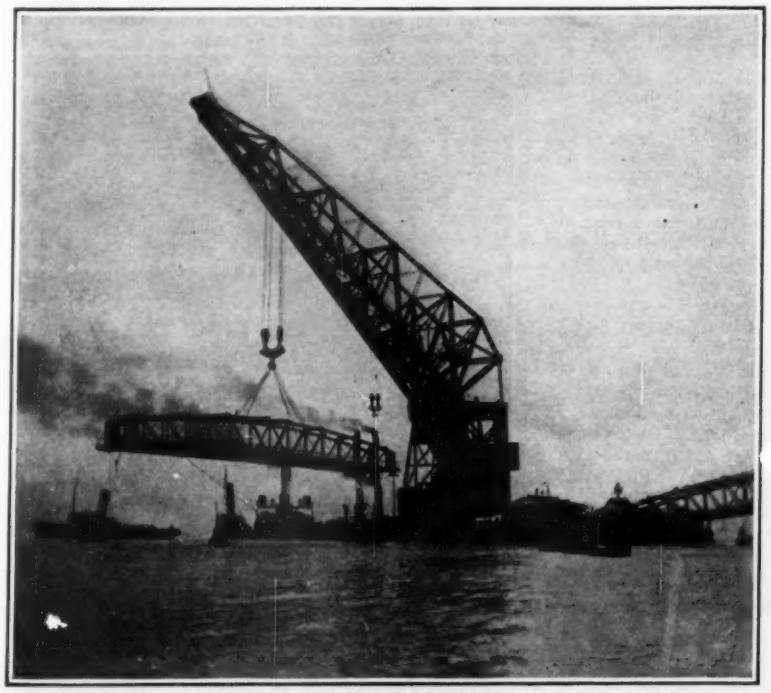
A four-inch water meter is installed in the suction line leading from a 3000-gallon water storage tank to the pump and a pressure gage, as well as a quick opening valve installed in the discharge line near the pump. For the purpose of regulating the water curtain, as well as being necessary to block off the line not in use, a screw stem gate valve was installed in each line to each individual tank, and a pressure gage connection was placed in each line near the tanks.

This installation gives sufficient flexibility to regulate to a nicety the water curtain desired, in addition to being able to take readings on water consumed, pressures developed, friction head loss in line, etc.

The water distributor is the invention of a San Francisco fireman by the name of Murray.



Experimental fuel oil tank equipped with a new system of water distributors for distinguishing oil fires



Giant floating crane lifting a 140-ton bridge, intact, to the crane pontoon, during a job of reconstruction

A Crane Which Removed a 150-Ton Bridge Intact

OUR illustration shows how a large floating crane, because of its great lifting power, may effect under certain conditions a considerable economy in time and labor. In this case a new 200-ton floating crane was brought into service in connection with the reconstruction of the landing stage at New Brighton near Liverpool. As part of the work, it was necessary to remove the two steel passenger foot-bridges, leading from the end of the ferry pier to the floating landing stage. One of these is 122 tons in weight and 160 feet in over all length. The other weighs 140 tons and measures 177 feet over all. The work was done in December, and because of the heavy tide which runs at times at 7 knots in the Mersey, and also on account of the unsettled weather in December, it was necessary to complete the job of removal in one day.

After the floating crane had been brought alongside the landing stage, the bridge was lifted by four slings attached to the lower chords of each of the main girders at about the third-points, the slings consisting of specially flexible wire rope, six inches in circumference. Each double sling passed around a hardwood block on the under side of the bottom chord.

When lifted, the overhanging portions beyond the slings were, of course, subjected to complete reversals of stress, tension members becoming compression members. The diagonal tension bars in the overhanging portions were relieved of compressive stress by means of slings passing from the upper panel point to the opposite lower panel points in the opposite direction to the tension bars in those panels.

In the work of removal, the 200-ton crane was towed up to position alongside the landing stage; the jib was slewed around over the bridge to be lifted, and the lifting hooks made fast to the slings above mentioned. In five minutes the bridge had cleared its bearings on the pier. The jib with its load was then slewed round and the bridge deposited on the deck of the crane pontoon. The crane was towed some two miles and moored to the river wall just south of the Seacombe Ferry, where the bridge was lowered on to timber grillages prepared to receive it. The work of removing the two bridges, transferring them two miles to their temporary resting place, bringing them back, and putting them in position again, was done without any mishap.

Auxiliary Condensers and Loading Coil

A FOURTH circular in the series of descriptions of very simple radio receiving outfits prepared by the Bureau of Standards has just been issued. This is Circular No. 137 entitled, "Auxiliary Condensers and Loading Coil Used with Simple Homemade Radio Receiving Outfits," and can be obtained from the Government Printing Office at 5 cents a copy.

Circulars 120 and 121 described a single-circuit receiving set and a two-circuit set, respectively. The operation of either set can be improved by the use of a very simple and cheap condenser connected across the telephone receivers and a similar one connected in series with the antenna. Longer waves can be received by the use of a very simple type of loading coil which is particularly useful in connection with the single-circuit receiving set.

The auxiliary condenser, which is used in series with the antenna and the loading coil, may also be used when the crystal detector is replaced by an electron tube detector unit (as described in Circular No. 133), or when an amplifier (to be described in a later circular) is added to the receiving set.

The condenser used in series with the antenna makes it convenient to tune to wave lengths less than 300 meters. The condenser used across the telephone receivers increases the intensity of signals which are received from some radio stations. The loading coil enables the equipment to respond to wave lengths above 600 meters, up to about 3000 meters. Time signals from high power stations can thus be received.

Concrete in the Making

Ingenious Production Methods Evolved in the Portland Cement Industry

By George S. Eaton

MOUNTAINS of rock, in effect, must be powdered yearly in the portland cement plants of the country before the carefully proportioned raw mix can be put through the flaming kilns where it is burned into clinker. This glass-hard material in turn is pulverized to produce portland cement. And since the substances that must be reduced in such quantities to the fineness of flour are solid rock and harder clinker, special equipment with many novel features has been developed to do the work economically and rapidly. Huge plants housing much ingenious machinery now supply this basic building material for use in all sorts of concrete structures and pavements.

Without two great inventions, the portland cement industry could not have attained its present development. One of these was the rotary kiln, which has entirely replaced the old dome types of kilns in this country. Although greedy for coal, the rotary kiln is low in labor cost, and what is of greater importance, makes production on a mammoth scale feasible. Instead of a scant hundred barrels a day from the improved continuous dome kiln, the modern rotary can turn out a thousand barrels, or some five carloads.

Coincident with this development in kilns, and of equal importance, came the evolution of the iron grinding mill. Anyone who is familiar with an old-time plant with its forty or fifty mill pickers busy with their hammers "sharpening" the burrstones once used in grinding materials will admit that present-day outputs would not be practicable without the highly-developed iron or steel grinding apparatus of today. And the development in either of these two mechanical fields alone would have been insufficient—their correlation was essential.

The huge rotary kilns found today in the cement plants of the country make most unusual furnaces. If one of the largest could be set on end it would be as tall as a 20-story building. It is more than big enough for a touring car to pass through. It is heavier than four standard pullman cars. Several of these steel monsters slowly revolving side by side in a great kiln room, with 30-foot tongues of flame roaring within them and white-hot balls of clinker dropping from their mouths, create an impression of power and relentless purpose that is unforgetable.

The raw mix, consisting of properly proportioned and finely powdered ingredients, enters the upper end of the kiln. As this slowly turns, a revolution every minute and a half or two minutes, the powder is carried up the sides before it tumbles down and forward, due to the kiln's slight inclination to the horizontal. Any moisture in the raw mix is soon driven off, and as the material grows hotter and hotter, the lime carbonate begins to give up its carbon dioxide. By the time the temperature reaches 1650 degrees Fahrenheit, a third of the original weight of the mixture has gone up the stack as carbon dioxide alone. If a pure limestone were being used without the clayey elements added, the loss from this source would be 44 per cent.

A centrifugal type of mill for pulverizing material in the cement plant

Now the material begins to get really hot, with good cause. Near the lower end of the kiln the flames attain a temperature of from 2500 to 3000 degrees Fahrenheit —a heat great enough to melt the steel shell of the kiln if it were not for the protection of the fire-brick lining. At this temperature, the materials are at the point of incipient fusion, and in their finely powdered state, react chemically to form the clinker that is later ground into portland cement.

The fuel employed to produce this extreme temperature is usually powdered coal, itself the result of pulverizing operations like those to which the raw materials are subjected. Coal so finely ground burns almost like a gas flame. Millions of tons of pulverized coal are consumed every year in the kilns of the cement mills. Great quantities of fuel oil and natural gas are also used.

Control of the burning is a most important feature in cement manufacture. The visitor at a cement plant will notice standing near the flame end of the kiln a workman who from time to time holds up a pair of goggles and peers into the great cylinder. Protected by these colored glasses, he is looking into a veritable inferno of heat, noting the appearance of the clinker as it tumbles over and over on its slow advance toward the outlet. From this inspection, with the aid of the more precise information furnished by recording pyrometers and draft gages set near the exit from the kiln to the stack, the burner is able properly to control the clinkering action by varying the amount of coal blown in and the rate of rotation of the kiln.

Occasionally rings of clinker form some distance back from the lower end, materially cutting down the effective diameter of the kiln and actually damming the flow through it to a considerable extent. These rings may become three feet thick and extend into the kiln 10 to 12 inches from the lining. To remove them with hand tools necessitates stopping the kiln and letting it cool down, with the certainty of a loss in production and the possibility that too rapid cooling will cause the shrinking fire-brick lining to crack. To eliminate this large operating loss, some ingenious fellow devised the plan of shooting a notch out of the ring, causing it to collapse.

Shotguns handling a charge of one ounce of lead are employed because of the bulk of the ring. Rapid fire is essential, so that eight or ten guns are provided in order that they will not become too hot. One man fires while others load. The blast of coal dust is shut off to afford a clear sight, but the kiln is allowed to revolve in order to prevent the clinkers sticking to the lining. From 500 to 1000 shots must often be sent into the moving target, which means that the marksman's shoulder receives a terrific pounding from the recoil of the heavily loaded guns. Unusual as it is, this plan has been used with much success at some plants.

Clinker is an interesting material in itself. It is formed by the physical and chemical union of the particles of raw materials brought into close contact at the very high kiln temperature, which, however, is still below the true fusion point. It consists of dark colored pieces, roughly spherical, ranging in diameter from one-quarter of an inch or less to as much as two inches. Even though the raw mixture includes such materials as clay or marl, the resulting clinker is glass-hard and difficult to pulverize. It is a totally new material.

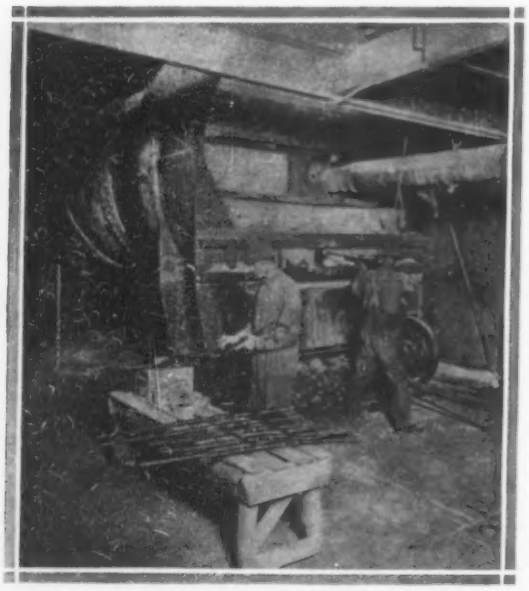
Then there is the matter of color. Although clinker is almost black, the cement made by grinding it finely is gray in color. The only addition to the clinker is about 3 per cent of gypsum, which has little effect in coloring the cement. The latter's much lighter color is due to the difference in the absorption and reflection of light by the clinker before and after pulverizing. Powdered materials often exhibit some such change in color.

While clinker needs only to be ground to become cement, which is a substance that will soon solidify into a permanently rigid mass upon the addition of water, clinker itself is inert and can be exposed to the elements for months without deterioration. Frequently it is sprinkled with water while cooling. Fine pulverizing is necessary before any cementing action can take place.

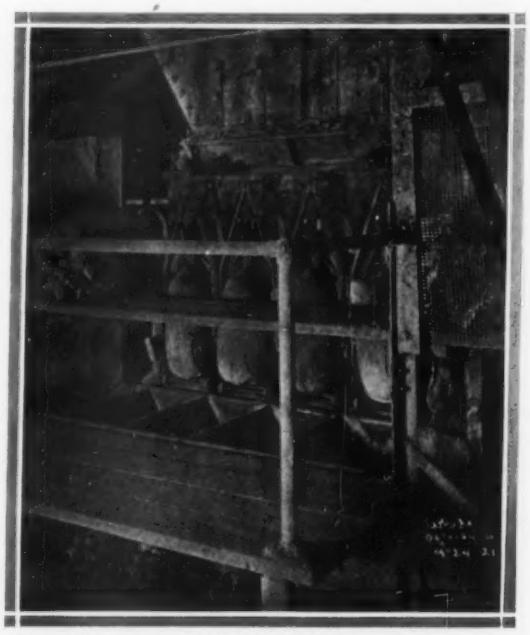
Present grinding machinery commonly utilizes the principle of pounding the material between some form of hammer and another metal mass. But the hammer may be a steel ball.

For example, a charge of several tons of steel or chilled iron balls hammers the rock fragment into bits in the ball mill often used in the first stage of grinding rock or clinker. This mill is a horizontal steel cylinder six to eight feet in diameter and four to six feet long. It makes a revolution every two and a half seconds about its horizontal axis. The balls used are of two sizes; the larger are five inches in diameter and weigh about 19 pounds each. In use, these balls rapidly wear away, so that from time to time the worn ones must be replaced by new balls.

As the cylindrical mill rotates, the balls are carried up the ascending side only to be thrown out and down to the bottom again. The principal grinding action is said to lie in the sharp blows delivered by the falling balls as they strike the particles caught between them



Shooting a notch through a clinker ring in a kiln may save a two-day shut-down



The sacks are first tied, then filled bottom side up by the packing machines

and the others at the bottom of the drum. The crushed material, passing a two-inch ring, is fed in at one end of the cylinder. When fine enough, it passes out through an enveloping screen that is fastened to the steel lining plates, and rotates with the mill. The particles leaving the ball mill commonly are about the size of medium-sized sand grains.

Other machines often used for grinding are known as hammer mills. In these, swinging hammers deliver the blows that break up the materials. Still other even more common types are called centrifugal mills, since their operation is dependent upon centrifugal force.

In one particular kind of centrifugal mill a single steel roll is suspended on a vertical shaft attached to a pulley by a universal joint. The roll is rapidly rotated, and swings out as it revolves until it bears against the inner face of a steel ring or circular die with great force. The pieces of rock caught between the two are ground up. When fine enough, these particles are sucked up and forced through enclosing screens by fans set over the roll. Such a mill is an efficient pulverizer.

Steel cylinders 20 feet or more in length are very often employed in reducing the product coming from the ball mill to the very fine powder that is fed into the kilns. These are filled about half full with flint pebbles, or more commonly since the war, with steel balls and slugs. The latter are small cylinders about an inch long by a half inch through. Such mills are known as tube mills.

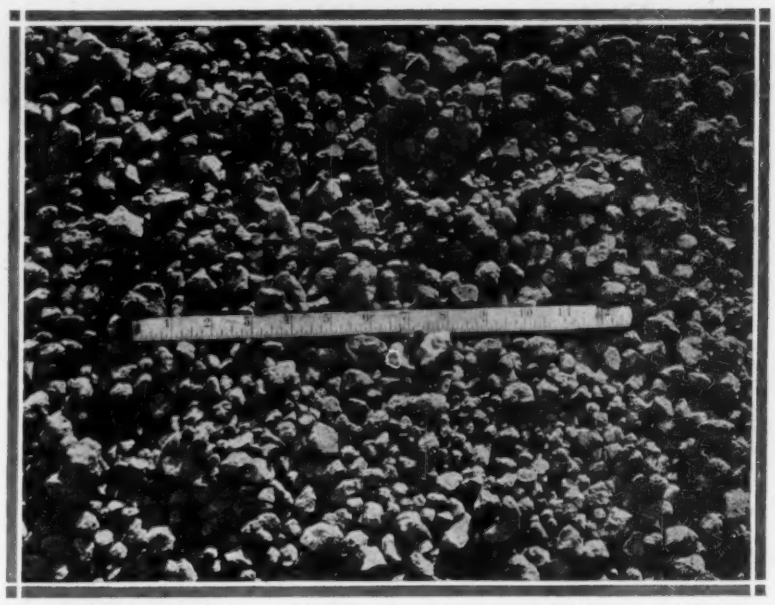
Almost any operation in the long manufacturing process contributes something unusual. For example, consider the sacks of cement seen on practically any construction job. Very prosaic in appearance, certainly—yet those sacks were securely tied with steel wire before they were filled with cement. This operation of filling a fastened container is performed many millions of times a month, for in 1922 enough portland cement to fill over 455,000,000 of them was produced in this country.

Less than 20 years ago the filling of cloth or paper sacks with cement was still a slow, back-breaking operation. Cement was stored in bins and workmen filled the sacks with shovels. As every sack had to contain 94 pounds, it was necessary to stop and weigh each package before it was tied, adding materials as needed to bring it to the standard weight.

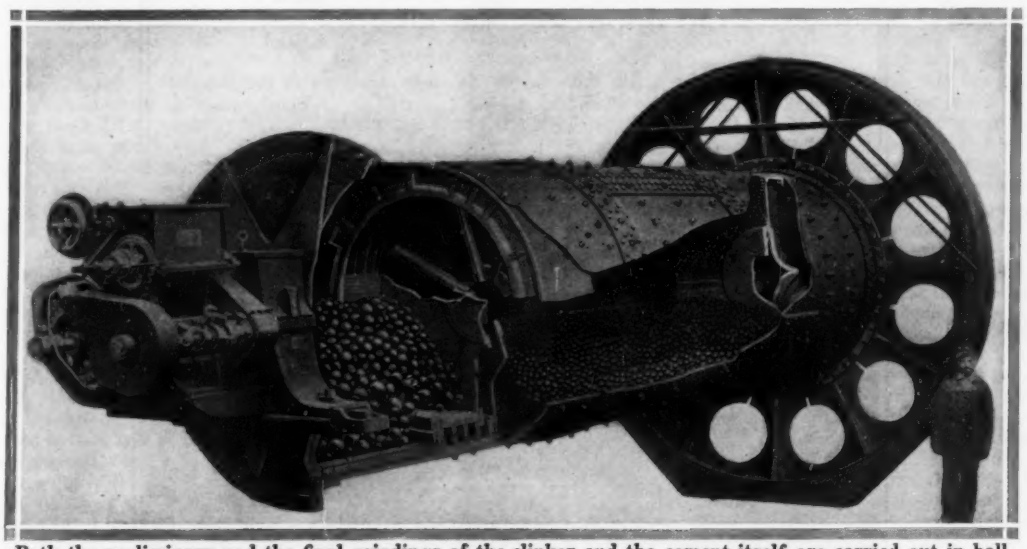
Today the filling is done by machines, and these machines have brought with them this type of sack that is tied before it is filled. The sack is provided with a self-closing valve in the bottom through which cement flows in, aided by an elaborate mechanism.

When the requisite 94 pounds of cement have been put into the bag, the flow is cut off by means of a scale, automatic in operation. The full sack then drops to a moving belt that carries it out to the freight car. By this method a crew of four men can fill and load 8000 sacks a day against an output of 1600 under the old hand-labor methods.

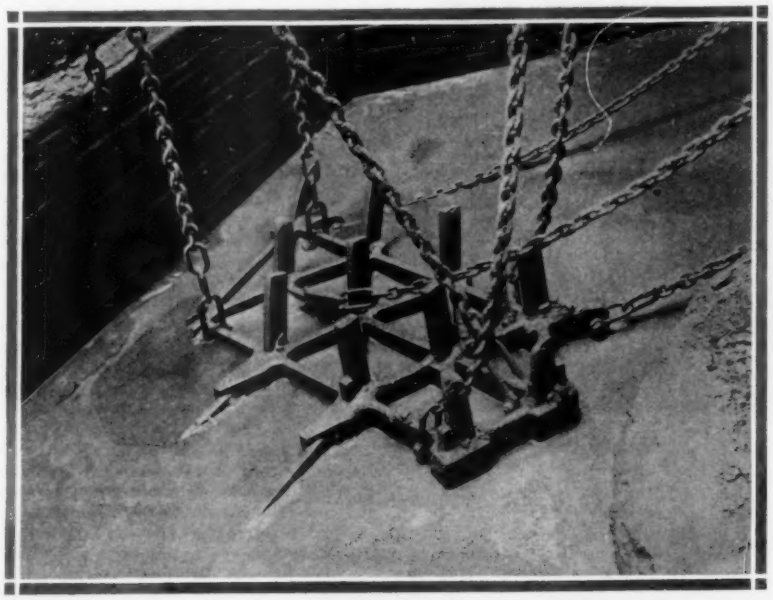
The valve itself is made when the cloth sack is sewed up, by folding over one bottom corner before a seam is run along the bottom and up one side of a doubled strip of cloth. When the sack is now turned right side out, this flap valve forms an inlet through which cement can flow. The sack is hung on the filling machine upside down, with an inch tube inserted through the valve. Once filled and righted, the sack is proof against leakage, since the weight of the cement holds the flap valve closed.



Cement clinker is an inert substance, but when ground into cement it soon hardens on addition of water. The grinding brings it down from the size shown, to an almost impalpable powder that will pass through silk cloth



Both the preliminary and the final grindings of the clinker and the cement itself are carried out in ball mills of one sort or another, of which this drawing shows a typical example, broken away to reveal the mechanism



The harrow used in breaking up lumps in the clay used in a wet-process portland cement plant. Without this, it would not be possible to get the necessary uniformness in the "slurry" or mixture

In the raw materials from which portland cement is made, the major constituents—lime, silica and alumina—must be present in the right proportions. Also they must be unaccompanied by injurious amounts of other ingredients. Proximity to centers of population is desirable, as freight charges mount up rapidly upon such a heavy, low-priced commodity as cement. This means that usable deposits suitably located for economical manufacture are comparatively rare. Yet the raw materials themselves are a small part of the cost of cement manufacture, as it is the great amount of machinery, the fuel for burning the clinker and the power needed to operate the mills that are the important factors. Last year portland cement was made at 117 plants in 27 States located in all sections of the country.

The combinations of materials commonly burned together in manufacturing cement are limestone with clay or shale; limestone with blast furnace slag; cement rock with limestone; and marl with clay. In each case, the principal constituent is named first.

Cement rock is a stone, found principally in Pennsylvania, that combines the necessary elements in approximately the correct proportions. Marl, in the sense meant here, is a granular, loose deposit of limestone found in the basin of an existing or extinct lake. The blast furnace slag referred to is especially prepared for cement manufacture by granulation while molten. Two general processes of manufacture have been developed, the dry and the wet. These vary in methods but not in principle.

In the dry process, rock is crushed to a two-inch size by passing the pieces from the quarry through some sort of a primary crusher, followed by a battery of smaller ones. Materials are next dried, and then go to the grinding mills for pulverizing before they are burned.

Slurry is the term applied to the raw mix in the wet process, used where marl is an ingredient and in some instances with limestone instead. Enough water is added to the materials so that they can be ground into the soupy mixture called slurry. This is often reduced to an even finer state than is the case in the dry process. In order to secure a uniform mixture, harrows much similar to those used on the farm, but with enormous teeth, may be dragged around in the tanks into which the clay is dumped from storage before it is added to the other material. Giant paddles revolving in the slurry tanks prevent settlement of the particles and compressed air blown in at the bottom bubbles up through the mixture, keeping it continually agitated. The slurry is pumped like water into feed tanks, from which it passes to the kilns.

Careful methods of control in manufacturing cement have of course been worked out by the cement plant chemical and physical laboratories, as the product is sold to conform to the specifications adopted by the American Society for Testing Materials, and the United States Government.

Among the many unusual pieces of apparatus relied upon in testing cement, none is of greater interest than the 200-mesh sieve. One of the requirements is that

(*Continued on page 143*)

Where the Temperature Is 434 Degrees Below Zero

The Work of the Bureau of Standards in Liquefying and Freezing Hydrogen, Lightest of Gases

By S. R. Winters

THE LOWEST temperature ever recorded in Washington, D. C., and possibly the coldest degree yet attained in the United States, was achieved recently when Dr. C. W. Kanolt of the Low Temperatures Laboratory of the Bureau of Standards, United States Department of Commerce, produced solid hydrogen. The thermometer would have registered 434 degrees Fahrenheit below the commonly accepted zero point, and only 25 degrees above absolute zero, which is 459 degrees Fahrenheit. Liquid hydrogen was manufactured at a temperature of 421 degrees Fahrenheit, the fluid then being easily transformed into flakes resembling snow or ice.

Hydrogen—a gaseous element that is colorless, tasteless, odorless, and the lightest known substance—has heretofore been converted into a liquid and a solid. About a quarter of a century ago Sir James Dewar, a noted English physicist who died on March 27, 1923, first produced liquid hydrogen, and two years later he realized the production of solid hydrogen. Dr. C. W. Kanolt and his co-laborers at the Low Temperatures Laboratory of the Bureau of Standards, however, are probably the first scientists to achieve the distinction of devising a method whereby both liquid and solid hydrogen may be dependably manufactured in quantity production.

Uncle Sam is tackling the production of liquid hydrogen with a two-fold object in view: First, gaseous hydrogen lends itself to the attainment of extremely low temperatures, and by extensive experiments the Bureau of Standards contemplates that this operation will be established on a practical basis. Second, these investigations have for their purpose the solution of difficulties arising from the methods of manufacture, thereby facilitating the installation and operation of hydrogen liquefiers in Government and university laboratories. A relatively small quantity of liquid hydrogen was first manufactured at the Bureau of Standards several years ago by T. B. Ford, then a member of the staff of the Low Temperatures Laboratory. He employed old and extremely troublesome machinery. Recent experiments, however, have been negotiated through the use of newly installed apparatus, and two liters of liquid hydrogen can be produced hourly without experiencing much difficulty from the clogging of the machinery.

The method of converting gaseous hydrogen into a liquid state is somewhat analogous to the process of manufacturing liquid air. Briefly told, this method consists of, first, in compressing the air to a high state of compression, approximately 200 atmospheres, or the application of 3000 pounds of pressure to the square inch. The resultant heat is displaced and the air is partly purified. It is then preferably, but not necessarily, pre-cooled to a point of a few degrees below ordinary or room temperature. The air is subsequently given passage through a heat interchanger and permitted to expand to atmospheric pressure through a valve. The expanded air is allowed to pass back over the heat interchanger as a means of cooling the incoming compressed air. Thus a negligible quantity of cold is squandered. The apparatus cools until a portion of the air is transformed into a fluid.

Hydrogen is liquefied in a similar manner, save in one essential particular. Instead of beginning the process of manufacture while the gaseous hydrogen is at room temperature, the compressed gas is first cooled to approximately minus 200 degrees Centigrade, which descending point on the thermometer scale is attained by the forced evaporation of liquid air under reduced pressure. Several difficulties are encountered during the course of this process of manufacture, notably among these obstacles being the impurity of the hydrogen. The slightest trace of air in the latter will freeze out solid air in the expansion valve and speedily clog the mechanism. This untoward circumstance may occur even when the hydrogen seems to possess 100 per cent purity, according to the conventional methods of gas analysis. The absence of extremely sensitive apparatus for making determinations of the purity of gases is responsible for this condition.

Nitrogen is the objectionable impurity in hydrogen. Thanks, however, to a process developed at the Fixation Nitrogen Laboratory of the United States Department of Agriculture, it is possible to analyze gaseous hydrogen at the different stages of its production and use, and locate the sources of contamination. For its own needs the Bureau of Standards is manufacturing hydrogen by the electrolytical method. This gaseous substance is collected in a holder, containing oil instead of water, and is compressed into cylinders for storage. As the hydrogen comes from the generator it contains approximately one-hundredth of 1 per cent nitrogen, which, subsequent to compression in cylinders, possesses two-one-hundredths per cent of nitrogen. The oxygen gaining admission into the generator is eliminated as a separate element by an apparatus that dispenses sufficient heat to the gas to effect a combination of the oxygen and hydrogen. Any water present can be removed by common drying agents; and, in fact, the presence of a trace of water does not involve a serious difficulty. The use of a device for warming the expansion valve in the removal of a plug of frozen air, in the event of clogging, was temporarily attempted, but in recent operations this auxiliary unit has been discarded for the time being.

Liquid hydrogen is the lightest fluid known. The figure of speech, "light as a cork," is thrown into discard, when compared with the weight of hydrogen in a liquid state. A cork, for instance, sinks in liquid hydrogen because it is three or four times as dense as this fluid. A container of liquid hydrogen is so light that one cannot easily detect the presence of it in a vessel by any additional weight imposed. Its viscosity is exceedingly low—about one-ninetieth of that of water. Hydrogen in a fluid state, like liquid air, may be preserved for 24 to 48 hours by means of vacuum-walled containers. The latter are barriers to the entrance of heat from immediate surroundings. Pressure alone, however, will not preserve either hydrogen or air in a fluid state.

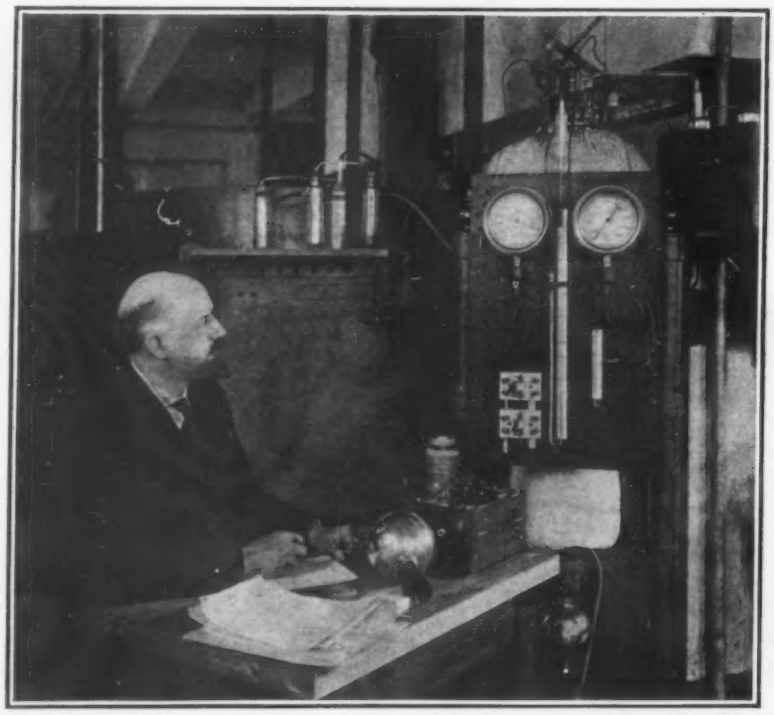
Once gaseous hydrogen has resolved itself into a liquid, the transformation to a solid is only a single step and one relatively easy of accomplishment. The fluid is reduced to a lower temperature—approximately eleven degrees on the thermometer scale—by rapid evaporation of the liquid in a partial vacuum. Solid hydrogen bears similarity to flakes of snow and ice and they are extremely light. It is difficult, if not well-nigh impossible, to preserve hydrogen in a solid form for any duration of time. For example, Doctor Kanolt was unable to carry a specimen from the laboratory for a distance of four or five miles before the flaky substance melted. However, according to the method being employed, it can be manufactured fairly rapidly and dependably in quantities desired. Solid hydrogen is the lightest solid known, it being one-third lighter than cork.

Sir James Dewar, inventor of the well-known vessel that bears his name, and the first person in the world to produce liquid hydrogen in a sufficient quantity to be positive of his achievement, recently died at his home in England. Fortunate, is it not that the efforts of his research should be continued without interruption and attain full fruition at the Bureau of Standards of the United States Department of Commerce? The Dewar vessel is essential to the process of manufacturing both liquid and solid hydrogen. The first liquid hydrogen placed on exhibit in the United States was that displayed by Professor Dewar at the St. Louis Exposition in 1903. Subsequently, Government agencies and educational institutions have spasmodically manufactured the rare fluid, notably in the laboratories of Kamerlingh Onnes, at Leyden, Netherlands; the University of California, in America; and laboratories in European countries. However, it remained for the Low Temperatures Laboratory of the Bureau of Standards, United States Department of Commerce, to apply a standard of precision and dependability of production in the manufacture of liquid and solid hydrogen. This is notable, not only on its own grounds, but equally in view of the fact that it means the development, regularly and as a matter of routine, of temperatures within twenty-five degrees of the absolute zero-temperatures which, a generation ago, no scientist would have attempted to reach save as an extraordinary laboratory "stunt."

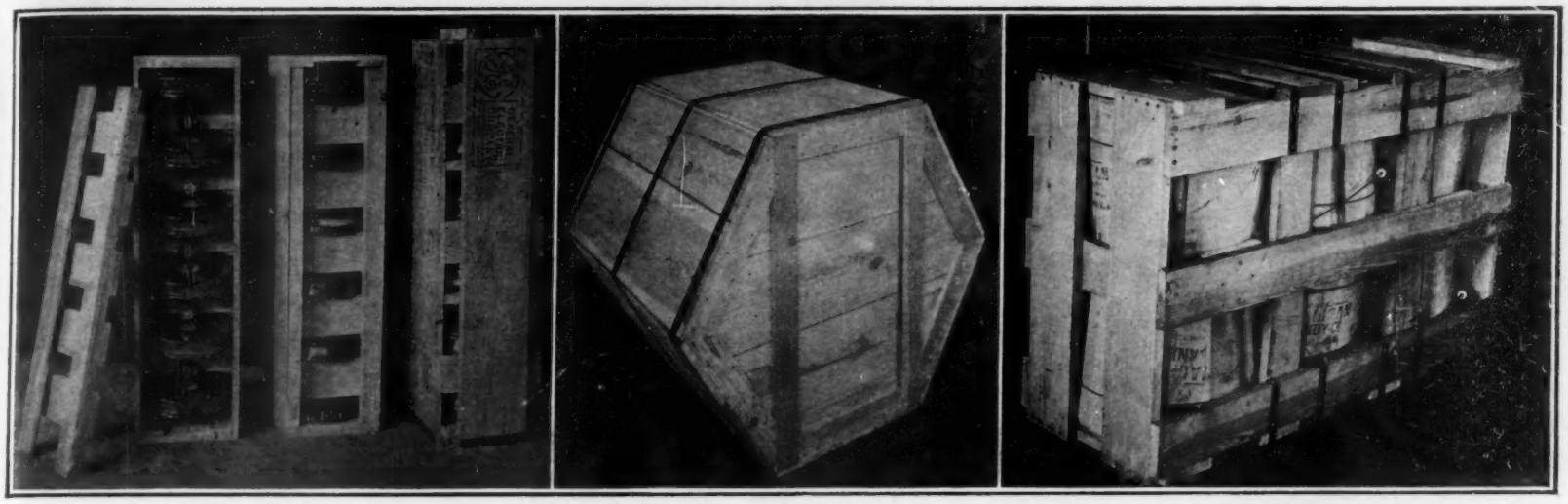
AS a standard against which to compare the freezing point of hydrogen, around which Mr. Winiers' story revolves, the following temperatures may be borne in mind:

Mercury freezes at	38 below
Coldest weather ever observed in U. S.	61 below
Coldest weather observed in world	90 below
Alcohol freezes at	142 below
Oxygen liquefies at	297 below
Nitrogen liquefies at	319 below
Nitrogen freezes at	347 below
Oxygen freezes at	360 below
Hydrogen liquefies at	421 below
Hydrogen freezes at	434 below
Absolute zero, at which matter may cease to exist	459 below

These temperatures, like those in Mr. Winters' text, are in the familiar Fahrenheit scale, rather than the Centigrade that is ordinarily used in scientific work.—THE EDITOR.



Dr. Kanolt of the Bureau of Standards at the hydrogen liquefiers, wherein he is producing liquid hydrogen regularly, in quantities



Left: How six porcelain insulators are combined to make a wieldy package, where one would be quite impossible. *Center:* The problem of shipping automobile tires without losing the tires or losing space is met by packing them in a hexagonal box. *Right:* This extremely clever crate carries six pails of candy for export in perfect security

Trick boxes that are necessary for long-distance shipping of merchandise of trick shapes

When the Packer Turns Inventor

AMONG the ancient proverbs there is one that tells us something about the advisability of cutting one's garment to fit one's cloth. Presumably the original author of this bit of sage advice did not know anything about packing merchandise for shipment. If he had, and if he had had before him the examples of how to perform this difficult task which we see at the top of this page, he might have modeled his proverb a little differently, making it have reference to the extreme advisability of building the box to fit the contents.

All of us, presumably, can make a fairly presentable job of wrapping a bundle—just so long as the bundle preserves the shape known to the mathematician as a parallelepiped. When the square corners make way to round ones or even to projections, and when the flat sides give place to eccentricity of outline, the difficulty of draping the article in paper and string is vastly increased. And when, instead of paper and string, it must be draped in a wooden box that will stand up against all the rigors of ocean freight shipment, the shipping clerk has a problem on his hands that calls for no little expenditure of gray matter.

One line of attack consists in the use of boxes or crates with internal partitions or compartments. High-voltage porcelain insulators are an example of the sort of merchandise requiring such treatment as this from the packer. They are of awkward shape to begin with, and breakable in the bargain. Instead of trying to make a box that will hold one of them, they are piled up, six high, in a long and narrow crate, as illustrated. With all the protecting parts of this crate, internal and external, in place and properly secured, the insulators are all fixed for a trip to any part of the world.

When we come to pack objects of curious shapes, the most natural thing to do, once we have visualized the problem that they present, would doubtless be to employ a specially shaped box that shall more or less conform to their outline. But if we do this without further thought we shall get ourselves in trouble. Ocean freight rates depend upon space occupied as well as upon weight; and if we turn over to the steamship a lot of oddly shaped containers that cannot be economically stowed away, we shall have our carelessness reflected on our freight bills in short order. Nevertheless, it is possible to ship trick articles in trick boxes, if we but make them of such shape that their projecting edges and corners will fit together well. The honey bee knows as well as the geometer that hexagons can be thus packed together; and the shipper of automobile tires knows it too, as our second picture shows.

The crate shown in our final photograph is in some respects the cleverest of them all. A pail of candy for shipment to a foreign land is indeed a problem for the packer. When he assembles six of them in the fashion shown, however, with proper packing to hold them in their crate without slipping, the difficulties of making a square package out of a tapering circular one disappear immediately. Simple as all these boxes are when we have once seen them, their simplicity is really much like that of the egg trick that helped to make Columbus famous; and their development required no little exercise of the inventive faculty.

Marking Laundry by Machine

THE mechanical marking room of one of San Francisco's large laundries, especially designed and installed, is the most mechanical marking room in the world. This is because it has specially designed conveyors which convey the bundles to the operator, and also conveyors which convey the goods from the operator to the classification room.

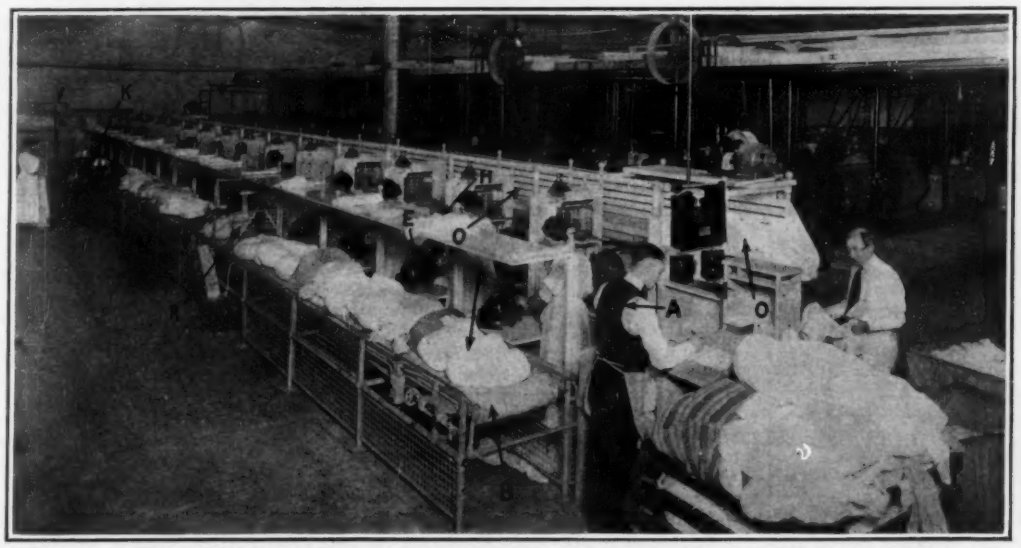
The bundles are opened by the operator shown in our photograph at *A*. He stands at the desk at the end of one of the conveyors, which delivers the bundles to him. His duty is to break the bundle, write the mark on the list, and keep a record of all marks given out, so as to prevent duplicate marks. The laundry list is then put back in the bundle, and the bundle placed on the conveyor as shown at *C*, the bundles being conveyed toward the markers in the booths, giving the markers an even distribution of work.

The conveyor, *B*, is provided with a special device shown at *R* and called a limit switch, which provides an automatic method of stopping and starting the conveyor. When the bundle of clothes on the conveyor travels to a point where it comes in contact with the limit switch, *R*, the electric motor that drives the conveyor is automatically stopped, and as soon as the marker removes the bundle that is in contact with this switch, the motor automatically starts up and drives the conveyor until another bundle comes in contact with the limit switch when the conveyor will again be stopped.

The following shows the steps through which the clothes are carried in this mechanical marking room. The marker in the booth removes a bundle of clothes from the traveling conveyor and puts it in her work box, finds the laundry list which has the mark thereon, and sets the mark on her machine. This machine has a keyboard, like an adding machine or typewriter. The marker picks up the first article on the top of the bundle with the right hand and "counts" it with the left hand. If it is a shirt the marker presses on the shirt key on the counting device, shown at *E*, marks the shirt and throws same to the take-off conveyor on her right, which is shown at *OO*, this conveyor delivering the goods to the classification room, from which point the goods are delivered to the washing machines.

When the marker finishes counting and marking the bundle in the manner just described, she lays the laundry list on the table of the counting device and lifts the table of the counting device to contact with the type and the count is transferred from the machine to the laundry list. This counting device adds up the number of each article, something like the ordinary adding machine, relieving the marker of this work.

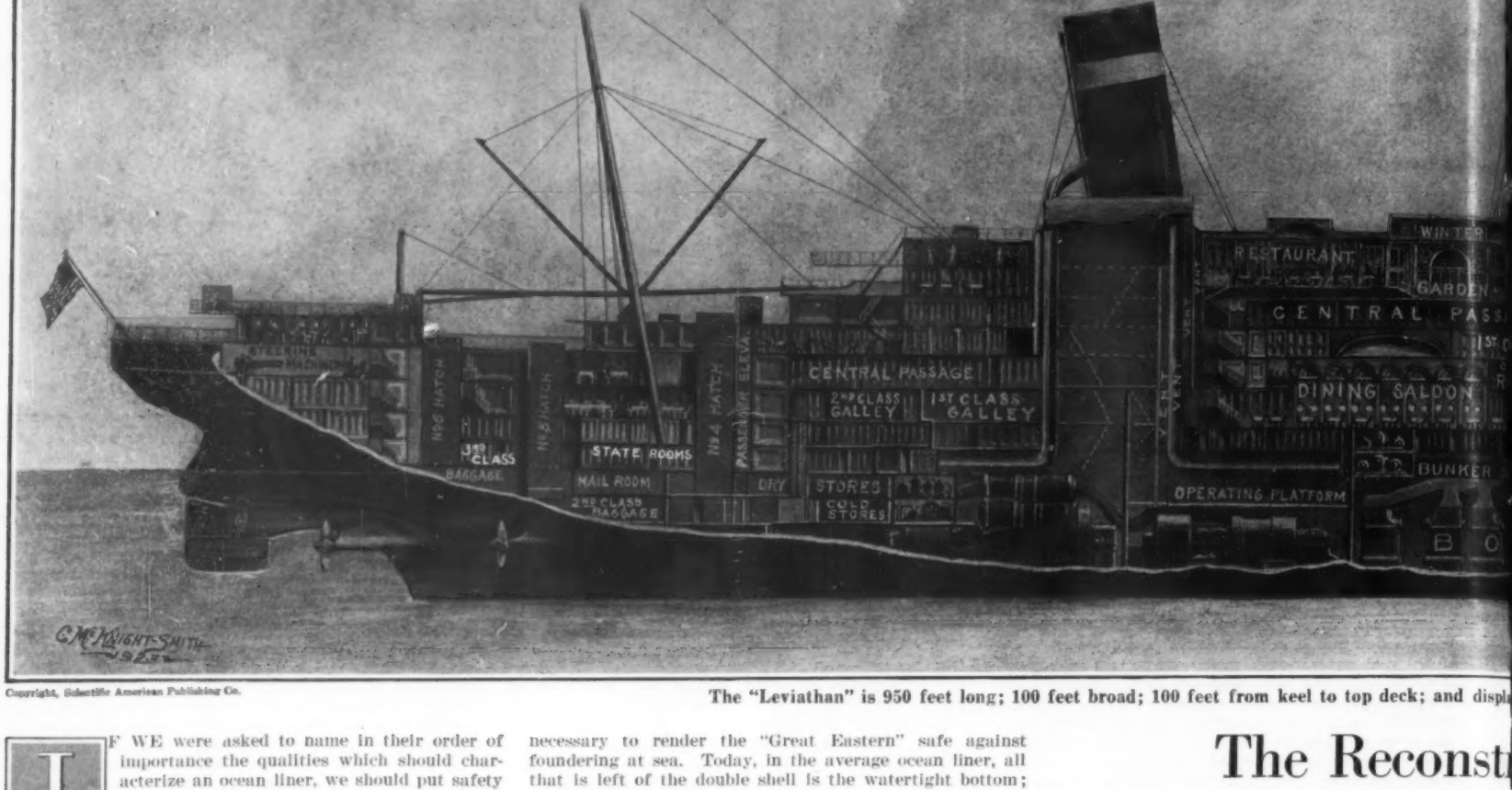
All articles in the bundle are handled in this manner, with the exception of the knit goods, table linen and dark colored goods, on which an ink mark will not hold, or which it is not desirable to mark with an ink mark. Goods of this class are laid on the top shelf—running the full length of the booths, at the left and shown at *H*. An operator takes these goods from this shelf and takes them to the machine shown at *K*. She sews a patch on each piece of goods with this machine, then puts the proper laundry mark on the sewed-on patch with the power marking machine shown at *V*. By combining these various conveyors with the marking and counting devices, a great improvement has been made over the method previously employed, under which all marking of the laundry and all counting of the various pieces and marking same on the laundry list was done by hand, with the aid of a single conveyor. The laundry industry ranks high in the application of labor-saving devices.



Where the methods that have been so successful in the manufacture of automobiles are applied to the marking of laundry. The reference letters are explained in the text

Finland Hydroelectric Plant

FINLAND'S largest hydroelectric power station, harnessing the energy of the Vuoksen Rapids, is well under way. The total head is to be utilized in four steps, the second being now under construction. When the plan is fully realized there will be a yield of 392,000 turbine horsepower, with a possibility of increasing this to 680,000 horsepower through controlling the water level of the Saima lakes.



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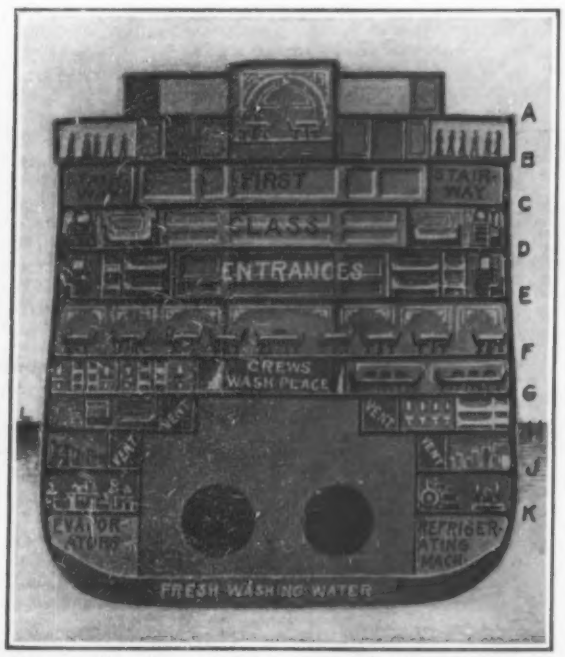
The "Leviathan" is 950 feet long; 100 feet broad; 100 feet from keel to top deck; and displa ons. He

IF WE were asked to name in their order of importance the qualities which should characterize an ocean liner, we should put safety first, then comfort, and then speed. With this statement the average ocean voyager will undoubtedly agree; for in setting sail for a distant port he will want to be perfectly sure of getting there with a reasonable degree of comfort, and at the highest possible speed consistent with the two major considerations.

The safest ocean liner ever constructed was the "Great Eastern," built three-quarters of a century ago. As a protection against flooding, she was provided with two complete hulls, the inner one three feet from the outer one, and the space between as many-celled as a honeycomb. In case both hulls should be pierced, she was sub-divided transversally by fifteen water-tight bulkheads, nine of which were carried to the top deck thirty feet above the waterline. During the fifty years subsequent to the "Great Eastern," the call for speed, luxury and dividends led to the gradual elimination of most of those protective features which the great engineer Brunell had considered necessary to render the "Great Eastern" safe against foundering at sea. Today, in the average ocean liner, all that is left of the double shell is the watertight bottom; and the transverse bulkheads, instead of being carried to the top deck, are liable to extend, as they did in the "Titanic," to only ten feet or less above the waterline.

After the loss of the "Titanic," a meeting of naval architects and shipping men of all maritime nations was called in London to determine what improvements should be made to render ships safe against sinking at sea. The rules adopted by the International Committee resulted in a certain increase in the safety elements of ship construction; but the writer has always felt that humanitarian considerations were given too little thought and considerations of dividends too much. As evidence of this, consider the fact that under the present rules for bulkheading, as adopted at that great international gathering, a ship is considered to be safe if, with two of her largest compartments flooded, she settles in the water until the top of her bulkheads is only 2½ inches above water.



Cross-section through engine room, showing eleven separate decks. Dining-room on F deck extends full width of the ship and is 120 feet in length

A Three-Compartment Ship

We have given this rather lengthy introduction in order to emphasize the fact that the "Leviathan" was so constructed that she greatly exceeds the above safety requirements and is therefore a thoroughly safe ship. If she should meet with an accident so terrific as to flood three of her largest compartments, her lowest bulkhead deck would still be floating at a higher level than that required by the bulkhead committee in a ship with only two of her compartments filled. It was to this question of safety that the naval architect, Mr. William F. Gibbs, who had charge of the reconditioning of the "Leviathan," gave his first attention. As he expressed it to the writer, "When I undertook the task of reconditioning the ship, I realized that the first obligation laid upon me was to render the "Leviathan" safe against being sunk by any reasonable accidents of the sea; and my first effort was to incorporate all the additional safeguards against foundering which it was possible to provide in a ship which was already built."

Lofty Bulkheads

When a ship is damaged by collision, the breach in her hull is usually forward of amidship, and she begins to settle by the head. If the bulkheads are low, the water rising within a forward compartment to the top of the adjoining bulkheads flows over into the next compartment, and so, by successive flooding, her buoyancy is ultimately lost and she sinks. Evidently the height of the bulkheads should increase from the center of the ship toward the ends. The lowest bulkhead deck (the bulkhead deck is the one to which the bulkheads extend) in the "Leviathan" is amidships, and is at an elevation of 13 feet above the load waterline. The other bulkheads, forward and aft, increase in height toward the ends, where five of them extend right through to the upper deck with a maximum height above the water line of 24 feet aft and 33 feet forward. Furthermore, to prevent buckling of the bulkheads or t trated i tearing loose, extra stiffening has been provided and all of wh tional rivetting to the tank top. In a rough sea, the s ing of the water within a flooded compartment prod heavy stresses on the bulkheads.

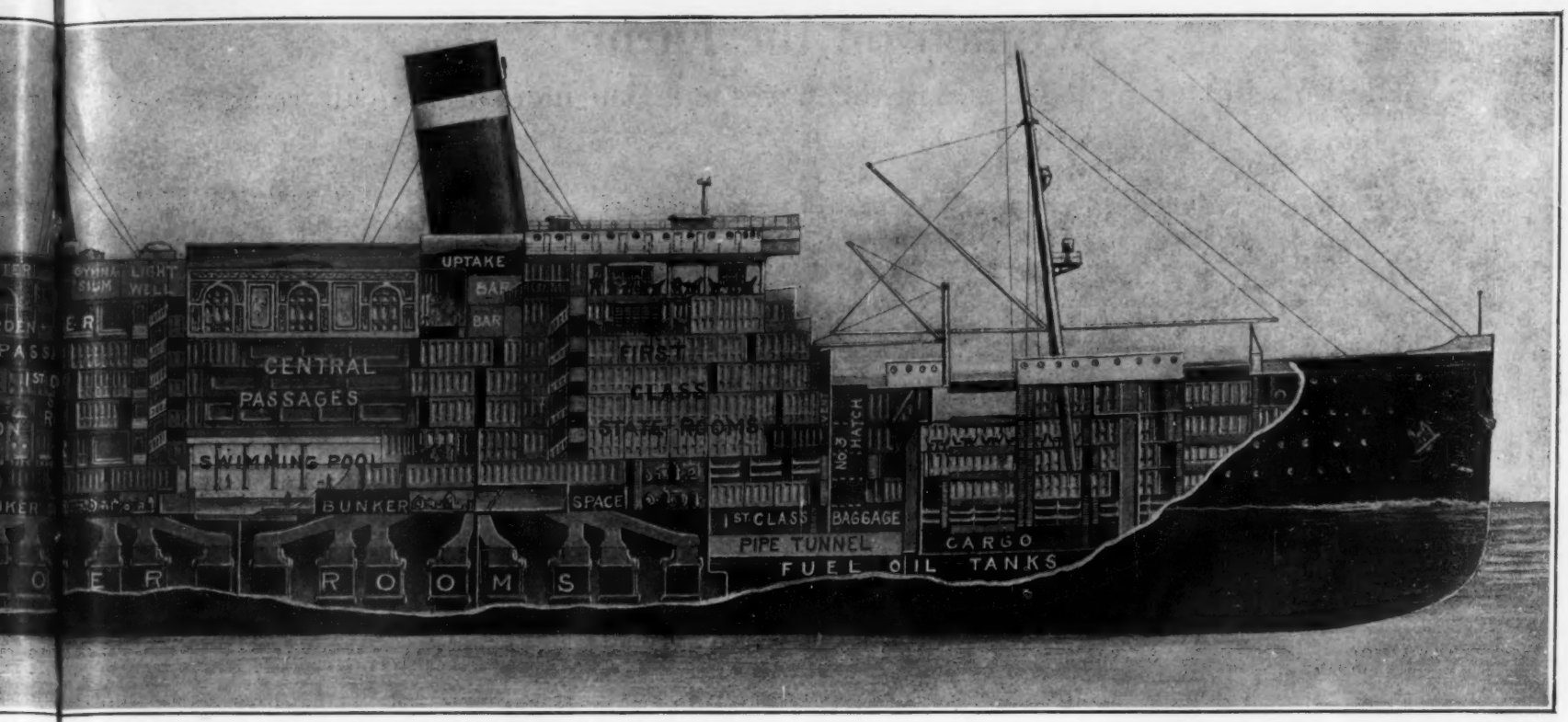
The Reconst d L

Story of the American Effort der t Fastest of the Three Ex-G

Permanently Closed Portholes

Open portholes constitute a serious danger to a ship, the extent of which is too little understood. A ship that is breached by collision heels quickly until she puts her lowest line of portholes under water. The amount of water that can enter a ship through a few open portholes, especially when it enters under the pressure of several feet of head, is enormous. To get rid of this great risk, Mr. Gibbs determined to abolish all hinged portlights below "F" deck. Hence, the portholes on two decks have been permanently closed by one-inch, triplex, glass lights and provided with interior steel portplates for use in case any glass should be broken. Consequently there can never be a porthole open below "F" deck, or for a height of about 20 feet above the load waterline. The many scuppers have been

A corner of the great social easures



d displ ons. **Her maximum horsepower is over 100,000. She carries 4513 passengers and crew**

nstd Leviathan

ffort der this Ship the Safest and Three Ex-German Liners

ds or trated in a few large hydraulically-operated scup- d and all of which can be closed from the bridge.

Bulkhead Openings Plated-Up

n the "Leviathan" was handed over for reconstruction, her system of ventilation for the boiler rooms was built on a plan which largely destroyed the effectiveness of the bulkheads as a provision against sinking. Fresh air was drawn in through deck openings abaft the bridge, and carried down to a large horizontal rectangular duct, which was built on the underside of the bulkhead deck and passed successively through all the boiler-room compartments. The air was admitted from this duct to each compartment through a hydraulically-operated door, which was to be closed in case of collision. These doors measure 5½ by 9 feet, and because of their liability to jam in an emergency, it was considered that the system was a menace to the safety of the ship. Therefore, the whole of this ventilating system was removed, and independent vertical ventilation shafts, leading directly from the top deck to each boiler room, were substituted. How greatly the margin of safety in the "Leviathan" has been increased by these and other changes, is shown by the fact that, whereas formerly she possessed 33 hydraulically-operated water-tight doors below the waterline, 18 of these have been removed during the reconstruction, and there are now only 15 such doors in the whole ship. As an additional safety measure, the deck above the engine rooms has been made water-tight.

social easures 26 feet from floor

Ballast Tanks and Pumping Plant

An important element in the protective features of a ship is the provision of ballast tanks and a powerful pumping plant capable of making a rapid transfer of water ballast to regulate the trim of the vessel. Great attention is paid to this feature in the design of warships, and the ability of some of the German battleships to remain afloat and get back to port, after being severally punished in the Battle of Jutland, was due to the excellent methods employed on their ships. This feature has received special attention in the re-conditioning of the "Leviathan." The capacity of the bilge pumps has been increased, and they can deliver overboard a total of 1780 tons of water per hour. Mr. Gibbs does not believe in the use of longitudinal bulkheads; for, by preventing the free flow of water across the ship, they increase the keeling. Hence they are regarded by many naval architects as a source of danger rather than a protection. On the other hand, a feature in the "Leviathan" which answers the same purpose as the double hull of the "Great Eastern," is the narrow oil tanks, which extend along the sides of the ship and flank the forward compartments. These have been made water-tight and hydraulically tested. It is claimed that the long, slicing blow which opened several forward compartments of the "Titanic" would not sink the "Leviathan," since it would merely open these oil tanks to the sea and no water would enter the main compartments.

Determining the Lines and the Weight of the Ship

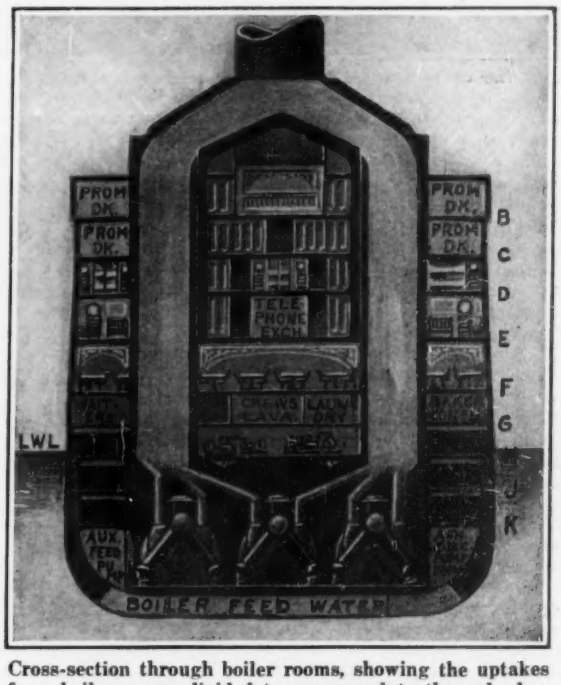
The strong sentimental hold of the "Leviathan" upon the American public is due to her wonderful record, when she carried over 150,000 of our soldier boys safely to France and brought them home again. When she was turned over to the Shipping Board for reconstruction, the Government was without a single plan of the ship. The Germans demanded one million dollars for these plans. Rather than pay that sum the Shipping Board determined to draw up complete plans based upon actual measurements of the vessel. This was an enormous task and necessitated the employment of a staff of 250 engineers and technical men who worked upon the job for several months. The lines of the ship were taken off from within, by offsetting from the central vertical plane of the ship. Some of these offsets has to turn as many as eight corners before they reached the shell of the vessel; yet the job was done so accurately that the form, as thus determined, was nowhere out more than one and a half inches from the hull as actually built. The cost of getting out these plans was about $250,000, or one-fourth of the sum demanded by the builders.

The ship itself, both as regards hull, boilers and engines was a good job, characterized by the efficient work which is found in first-class German vessels; but every part of the vessel was overhauled, and not only was a large amount of new auxiliary machinery installed, but many improvements were made, including entirely new systems of plumbing, heating and lighting, and the change of the boiler plant from coal to oil burning. These many changes are believed by the Shipping Board to constitute this ship the most up-to-date of all the great liners of her class.

Dimensions of the Ship

The length over all of the "Leviathan" is 950 feet, her breadth 100 feet, her molded department to "D" deck is 70 feet 4¼ inches, her loaded draft 40 feet, and her full load displacement 66,800 tons. She carries 1115 officers and crew and 3398 passengers, or a total complement for the ship 4513. Steam is raised in 46 modified, oil-fired Yarrow boilers, and power is developed on four direct-connected Parsons reaction turbines whose maximum power, with all overload nozzles open, should be well over 100,000.

(*Continued on page 143*)



Cross-section through boiler rooms, showing the uptakes from boiler rooms divided to accommodate the unbroken sweep of the social hall, Ritz restaurant, etc.

Women on the Farm

The Role in Our National Life of the Wives and Daughters of Agriculture

By George H. Dacy

DESPITE that the census classifies farm women under the heading "no occupation," these rural home-makers are among the busiest employed in direct agricultural activities or related lines of work. Daily their work begins just an hour or so after daylight—during the summer even earlier—while their hundred and one tasks usually engage their attention until after everyone else around the farm homes has gone to bed. No one has any record of "cum laude" or emeritus honors being bestowed upon farm women yet these patient, persistent and plucky toilers deserve the highest awards which can be granted to womanhood.

Heretofore, little attention has been accorded the conditions, environments, equipment and facilities under and with which the farm women of this country work. In fact the first detailed and authentic information along these lines obtains from a recent scientific survey which has been conducted by the national Department of Agriculture. In cooperation with the state agricultural colleges and the county demonstration agents, Uncle Sam has attempted to learn first-handed from the farm women, themselves, concerning the conditions under which they accomplish their daily duties. Complete records were received from 10,044 women who live in 35 different northern and western states. The data were gathered from carefully selected, typical farming communities in several of the leading agricultural counties of each of these states. Most of the localities covered contained from 35 to 50 farms and in the case of each section which was surveyed, a record was secured from every farm home in the neighborhood irrespective of the size of farm, character of tenancy, prosperity of the farm family or associated conditions.

This minute study of the daily doings of the average farm housewife shows that she plays many roles, from cook, seamstress, laundress and nurse to family purchasing agent, producer of dairy, garden and poultry products, teacher of her children and member of the local country clubs—if there are any. Her morning starts at five or six o'clock when she lights the kitchen range and begins preparations for breakfast. She draws the water for breakfast from a well or cistern located anywhere from 10 to 200 feet from the house—many of these sources of water supply being without pumps. On Mondays she beats the sun up and draws additional water to wash the family clothes. She is not aided by an electrically operated washing machine, wringer and like facilities as only one out of every 100 farms even has a mechanical washing machine. Usually she does the washing unassisted either by human hands or automatic appliances.

Generally when breakfast is ready, she awakens the rest of the family, dresses several children for school and prepares their lunches. When everybody's appetite has been appeased, the housewife has to wash the dishes, feed the chickens, wash the milk pails and cans, gather the vegetables from the garden during the summer or she has to carry them from the cellar during the winter for the subsequent meals. Then on all days except wash day, attention has to be devoted to the routine making of beds, filling and cleaning of lamps with mending and the ironing to occupy all the extra time which she does not devote to these essential tasks. Then there are the other two meals to get, baking, sweeping and dusting as well as the marketing to attend to—all competing simultaneously with a couple of dozen other hurry-up jobs for the time of the farmer's wife.

The national survey shows that 9000 of the farm women who were visited by Uncle Sam's representatives reported that they worked an average of 11.3 hours a day—the year around—while 87 per cent of them said that they never took any vacations during the entire year. For the most part, the complexity and tediousness of the various household tasks could be eliminated if the principles of modern business and efficiency were applied to the homely work of handling the farm home. If the general run of farm homes were as well equipped as the ordinary dairy barn with labor-saving appliances, the duties of the farm women would be materially reduced. Approximately 79 per cent of the farm homes reporting in this survey announced that they still used kerosene lamps—and these figures are probably quite accurate for the rural United States in its entirety. The installation of modern lighting systems would measurably lessen the toil of the farm wife and would make the rural home more cheerful and pleasant for the farm family.

There are some farm homes—but they are lamentably in the minority—which qualify as satisfactory and modern abodes and which eliminate the back-ache and drudgery from rural culinary and housekeeping pursuits. To a certain extent, a perceptible—although extremely minute—progress in increasing the standard of rural living is apparent in all sections of the country. Some homes in every community are divorced from the erstwhile hardships to which the housewives have long been accustomed. The telephone and automobile largely have freed the farm families from isolation; rural engineering has mastered the problems of sanitation; community centers have been productive of increased sociability among country folks while modern machinery has curtailed much of the laborious hand work formerly associated with both field and kitchen tasks. Despite all these easily available and adaptable facilities for improving general living conditions in the rural regions, Uncle Sam's survey shows that the rank and file of farm families is still sadly handicapped because they have not been able to realize benefits of this description.

As matters stand, the waste of rural womanpower each year is stupendous. Women waste valuable time in drudgery when with the assistance of some of the modern machines, they could not only perform routine, menial labors much better and at less cost but they also would have more time to devote to the more important tasks connected with the successful operation of their homes. Expert, healthy, alert, ingenious and active homemakers are the economic hubs around which the wheels of rural progress revolve. The government statistics indicate infallibly that if farm women—as a class—were permitted to exercise more brain power and less brawn in their daily activities, their innate ability—aided by efficient household appliances and modern methods of management—would enable them to do better work in less time than now is possible.

Seventy nine per cent of the farm homes in this country, at present, are yearning for modern lighting systems to replace the kerosene lamps now in use. Better lights mean a more cheerful home and operate directly for the education of the farm family as they would encourage more reading by the farm folks. Close to 54 per cent of the farm women not only have to start coal and wood fires each day during the cold period but they also have to carry the fuel and tend these fires during the day. Artificial lighting systems are not expensive; neither are heating systems and every farmer who neglects to provide these conveniences not only is increasing the drudgery and housework bondage of his wife but he also is paving the way for his farm children to migrate as soon as they are of age from the farm to the city where the conveniences are superior, where the wages are higher and where the opportunities for recreation, education and general development are more abundant.

Probably more than 50 per cent of the successful farms in America are equipped with some kind of artificial power such as gasoline or steam engine or even an electric dynamo. Despite this extensive

(*Continued on page 144*)

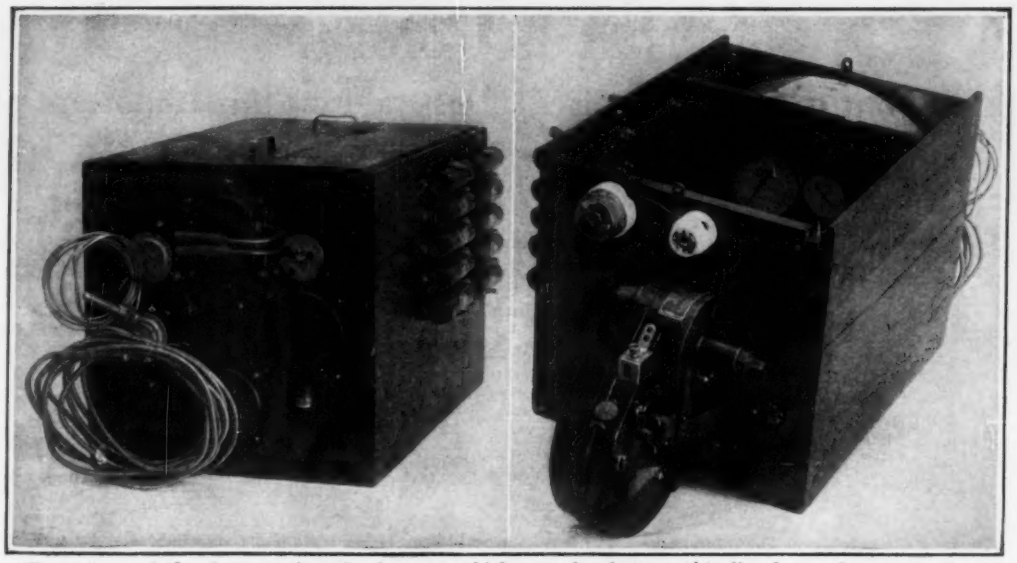
Left: Only one-tenth of one per cent of the farm women surveyed have hired help all the year around. *Center:* Eighty-one per cent of these women care for the poultry on their farms. *Right:* Showing the use of the kitchen cabinet and the fireless cooker, handy kitchen apparatus for use in rural homes

Some of the results of a survey of the women on 10,044 typical farms

A Dummy Aircraft Observer

THE dummy watchman in the corn field as a fright to crows is common in the corn-producing areas, but for the first time a dummy observer is being employed on aircraft. The aeronautic instrument section of the Bureau of Standards, United States Department of Commerce, recently developed such a device for use by the Air Service of the War Department in performance tests during aircraft flights.

In testing an airplane it is essential to know the actual conditions that prevail during the performance flight. Heretofore, a human observer noted the behavior of the air-going machine subject to test, but obviously there are limitations imposed upon the human eye in determining the action of the various instruments thus employed. Hence, the introduction of the dummy observer, which consists of a camera commonly used in the motion picture industry for photographing titles. Not only are the readings of a series of aircraft instruments recorded simultaneously on a film, but the inclusion of a clock among the recording apparatus makes possible the indication of the precise time at which the photographic exposure was made.



Two views of the dummy aircraft observer which records photographically the performance of an airplane or airship

The motion-picture camera is directly driven by a small electric motor through a flexible shaft. It is placed opposite the instrument board in the fusilage of the airplane subject to performance flights. The electric motor, operated by means of a storage battery, is located within the reach of the pilot, whose command of the dummy observer is reduced to the simplicity of turning on and off a switch in the cockpit. As indicated by the photograph illustrating this article, the performance test instruments are compactly arranged in a wooden box, including an automatic timing control for the camera.

Preliminary tests of the dummy aircraft observer by the Air Service at McCook Field, Dayton, Ohio, involved the photographing continuously on a motion picture film atmospheric pressure exerted on the upper and lower surface of the wings of an airplane in flight. Measurements of these various pressures were recorded at the same time. The behavior of aircraft could thus be photographed in normal horizontal flight or in the course of turns, loops, spins, or other stunts in the air. In other words, this camera visualizes on a film at specified intervals of time quite an array of performance test instruments.

When designing an airplane it has heretofore been extremely difficult to anticipate with any degree of accuracy the atmospheric pressures that the various parts may be expected to withstand. The aeronautic instrument section of the Bureau of Standards, in adapting the motion picture to the role of dummy observer, seems to have solved the problem. The pressure distribution exerted upon the horizontal surfaces of the tail-rudder, elevators, and stabilizers is obtained by connecting the atmospheric pressure instruments by means of tubing to the surfaces in question. The various instruments are calibrated in pounds to the square foot. The opposite sides of the diaphragm in these instruments are connected to the top and bottom, respectively, of the surface to be measured. Or differently expressed a surface that indicated pressure on the bottom and suction on the top would have the resultant action integrated in the instruments. And, in the course of the performance test flight, the exposed films indicate the instrument reading, or the air pressure at a particular point during any flying stunt which the pilot desires to throw the spotlight of searching inquiry.

According to the Bureau of Standards, this novel departure in registering instrument readings affords records that are more accurate than those obtainable by the conventional method.

The Latest Motion Picture Outfit for Amateurs

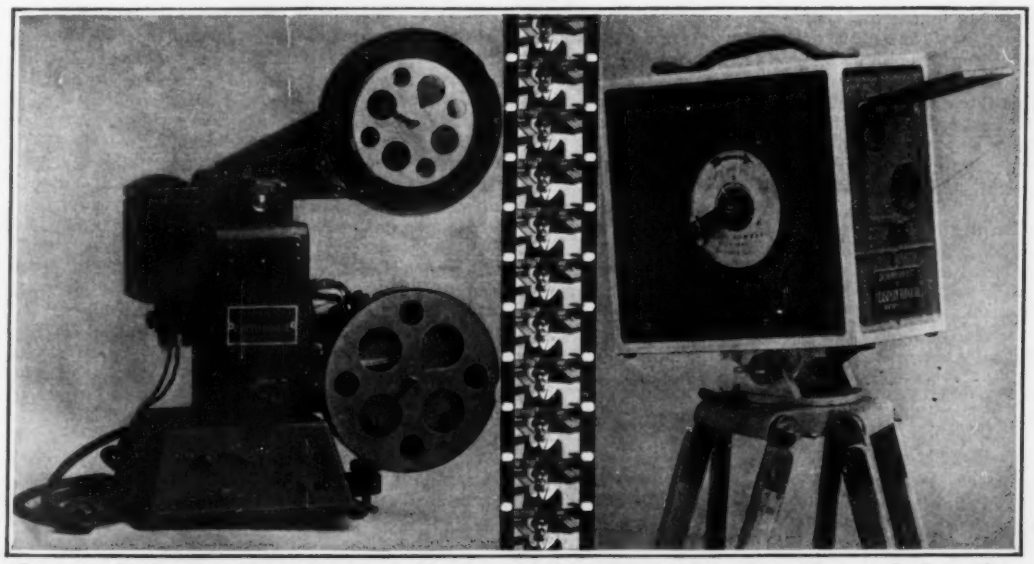
AN amateur motion picture outfit by which the amateur may take and project his own "movies" is the latest development of the leading American manufacturer of photographic apparatus. Dr. C. E. Kenneth Mees, director of the Eastman Kodak Research Laboratories, in making the announcement recently at Franklin Institute, characterized this as the most important photographic achievement since the kodak and film photography.

The outfit consists of a "taking" camera and a projector, both of which are illustrated below. The diminutive camera weighs only seven pounds and is said to be, relatively at least, as simple in operation as the usual kodak.

The film for the new movie outfit is 11/16 inch wide as against the standard width of 1⅜ inches, while each picture or frame measures one centimeter by ¾, as compared with the standard picture of 1 inch by ¾ inch. Five pictures on the small film consequently occupy the same length as two on the standard, so that 100 feet of Cine Kodak film is equivalent to 250 feet of standard, and a 400-foot reel equivalent to the standard 1000-foot reel. The film is of the non-inflammable type and coated with a special emulsion which enables the negative to be developed and then by a new process reversed to give a direct positive picture for projection.

The lens is an anastigmat working at f.3.5, permitting photographs to be made under poor light conditions. The finder is just above the lens and by an ingenious attachment changes the position of its image as the lens is focused. In this way the image is shown through the center of the field at all times. The lens has a focusing lever carried through to the back which can be focused for any distance from infinity to four feet. The diaphragm control is in the left-hand corner and can there be read easily. In the center of the back is a footage indicator showing the quantity used, in feet. The crank turns nominally twice a second, taking pictures at the standard rate of 16 per second. The camera is daylight loading, the film being supplied in a special magazine. After exposure the film is removed in its magazine and sent to the laboratory for development.

The Kodascope, which projects the picture on the screen, is motor driven and is entirely automatic in its operation. Once a film is threaded the machine requires no further attention until the reel is exhausted. For home projection a lens of two-inch focal length is used, the picture filling a 30 x 40 screen at a distance of 18 feet, and a 40 x 54 screen at 21 feet.



Projector for home motion pictures, the film shown actual size, and the camera set up ready for action

Why Is Talc?

FOR talcum powder, of course. But that is by no means the only use for it. There is talc on this page—in the paper, as filling. More talc is used in filling the pores of print paper than in camouflaging good complexions. Talc is also used as a filler for paint. Its discovery for that use was hardly accidental, yet it was not originally added with the intention of improving the paint, but of adulterating it. Later on, strange to say, paint chemists found it improved the paints for some purposes. Guilty consciences had been aching in vain, but now ached because a higher price had not been charged for the improved paint.

Talc is not at all rare. It occurs in many places, and the chief item that goes to make up the sales cost is caused by the preparation and marketing of the commodity. Found in its natural state it is a rock. Its chief physical characteristic is its soapy feeling, like graphite. The mineralogist calls it steatite, and it is a hydrous magnesium silicate. About 65 per cent of the world's talc is produced in the United States, the largest supply being in Vermont, which is so close to the centers of the paper industry that talc from other regions cannot compete.

The best grade of talc is used for talcum powder, which must be white—except in the case of talcum for men, which has a flesh color. There is nothing in talcum powder that is directly harmful. If earth is comminuted rock, and if talc is a kind of rock, then talcum is only a kind of clean earth, to which boric acid is usually added to give soothing effect. It is interesting to note how many kinds of rock, when broken up and crushed to the finest kind of powder, have the general semblance of talcum powder, although not the actual characteristics which are so necessary.

Not more than a generation ago, when the use of talcum powders became very general, it was said the skins of the growing generation would be ruined by its use. Yet the evidences of the eye say otherwise. The processes the natural product go through before it is passed over the druggist's counter insure that it is the cleanest of all dirt.

What Is Color?

Something About the New Theories of Ostwald on this Important Subject

By Ismar Ginsberg

LIGHT IS one of the many manifestations of energy. In order that it be produced, some other form of energy must be converted into light energy. Excluding the sun, our greatest source of light, we have two principal kinds of energy on the earth which can be thus converted. In the incandescent electric light or the electric arc, electrical energy is transformed into light; in the candle, the kerosene lamp or the gas jet, chemical energy is so transformed. In both cases the change is indirect, the original energy being first converted into heat energy and this to light. Direct conversion of electrical and chemical energy into light is known, but, as in the phosphorescence of insect and bacterial life, on a small scale as regards the resultant luminosity.

Light moves from place to place with great rapidity —some 183,000 miles per second. This characteristic light shares with certain other types of energy, such as radiant heat and electrical waves; all such are known collectively as electro-magnetic waves. In their passage through space, filled as it is with all sorts of bodies, the rays of light undergo changes in direction and intensity through contacts with these objects. Some of these bodies, like highly polished metallic surfaces, throw the light back into the space from which it emerged. This is reflection. Theoretically, if the surface were highly enough polished it could throw back all the light received, so that the reflected beam would have the same intensity as the incident beam, differing only in its direction. But this theoretic perfection is in practice never attained. Bodies vary in the amount of light they throw back into space, according to the physical characteristics of their reflecting surfaces; what is not reflected is absorbed or swallowed up, increasing the temperature of the body or being otherwise converted.

Other substances allow light to pass through them, like glass or water; according to degree, they are called transparent or translucent. In the course of such passage, the direction of the light is ordinarily changed, also. This is refraction; each body possesses its own individual capacity for refracting and absorbing, as well as for reflecting.

We have said that light is propagated in waves. This applies to all electro-magnetic energy; and light is distinguished from the invisible forms like the X-ray and the electric current only by being of certain wave-lengths. The eye is sensitive to electro-magnetic waves of lengths between .00004 and .00008 centimeters; anything below the one limit or above the other is invisible. And within these limits, waves of all lengths are found, and all affect the eye, but affect it differently. The difference consists in the different sensations of color. Light of a given wave length, or of a given combination of wave lengths, produces a given color sensation.

We find it convenient to divide the visible spectrum, or wave-length range, into six sections, calling these red, orange, yellow, green, blue and violet. When sunlight, in which no wave-lengths are missing, strikes a body, all these colors are present, and if all are reflected, the body will be of substantially the same color as the sun itself, differing only in intensity. If not all are reflected, we see the ones that are and, of course, fail to see those that are absorbed. Thus, if a body is red, we know that the orange, yellow, green, blue and violet rays have been absorbed, and the red reflected. The exact range of color resulting is a function of the three properties of reflection, refraction and absorption. If all the light falling on a body is absorbed, the resultant "color" is black or gray.

There are various ways of classifying colors. Ostwald starts with a very simple division. White and black he calls the dull colors, the six hues of the spectrum listed above he calls the bright colors. Within the dull series as within the bright, all gradations are possible, and we have a continuous series, with black at one extreme, and shading down through grays into white at the other. There is just one way in which one dull color can vary from another; in the percentage of black and white that it contains. When two such grays are mixed, we get a new gray, brighter than the one and duller than the other, and for which a place can be found in the series. Hence this series of dull colors is "uni-dimensional."

Black has ordinarily been called "no color," and taken to denote the absence of color. Likewise, white, being constituted of all colors, may also be considered as no color. A white body is assumed to reflect all the light that strikes it. There is no absorption and hence there is no color. A black body absorbs all the light that impinges upon it and reflects none, therefore there is absence of all color. Theoretically, this is true, but there is no white that will reflect 100 per cent of the light, and no black that will absorb 100 per cent of the light. We often hear of a whitest white, until a whiter one comes along and displaces it from its position of eminence. The same fact holds good for black. But, inasmuch as some white must be taken as a standard of comparison, a choice must be made of the whitest white. Pure barium sulfate is accordingly taken as the 100 per cent perfect white, the white which reflects all the light that strikes it.

From a practical standpoint it is equally incorrect to state that black denotes absence of all color. For one black is blacker than the next, and the blackest black, which is assumed to have no color at all, may be found to possess some slight trace of color when compared with another new black. Furthermore, as the eye is not absolutely perfect and as its sensitivity is not infinite, absence of light, as defined by the sensation produced in it, is relative only. Even the deepest black would exhibit traces of color, would reflect a little light, if our eyes were sensitive enough to detect it.

It is accordingly evident that all the colors of the gray series can be easily distinguished from one another by their brightness, in other words, by the percentage of light that they reflect, based on *blanc fixe* as the standard. This gives us a very convenient way of classifying and identifying the grays. For example, gray 95 is the designation given to the color that reflects 95 per cent of the light striking it. Such a color is white and is made from the purest zinc oxide. Gray 80 is the color given by the purest grade of chalk. This color already possesses a yellowish cast. All grays which reflect less than four per cent of light, may be considered blacks; and those that reflect more than 80 per cent of the light may be considered as white.

The bright colors are the ones that interest us most. The continuity of the spectrum might lead us to infer that these, too, constitute a uni-dimensional series. The fact is, however, that mixtures of several different wave-lengths usually produce a color sensation quite different from that given by any simple wave-length. We find, indeed, that the bright colors constitute a three-dimensional series or continuum. First, we may vary them by mixing them with one another in any desired proportions. Second, having got any of these combinations, we may mix it with any given tone of the white-gray-black series. Finally, having selected the two colors, one bright and one dull, to be thus mixed, we may effect the mixture in any proportion. So classification and identification of the bright colors is far from the simple matter which it is in the dull series.

We are all familiar with the fact that the red shades into orange, orange into yellow, and so on clear through to the violet. Not all of us, perhaps, have realized the significance of the further fact that violet can be shaded into red. This really means that the spectrum may be arranged in a circle, as well as in the straight line into which it is spread out by the ordinary prism or by the rainbow. We can break into this circle or "start" the circle at any color whatever, and pass clear around to return to the original color. Quite arbitrarily, Ostwald starts the color circle with the purest yellow, containing no trace of orange or green, and passes around in the direction that takes him first to green, and then through the blue, violet, red and orange back to the yellow.

From the color circle we can pick out the colors that stand directly opposite one another. These "supplementary" colors, if mixed optically by the rotation of a disk painted in equal halves with the two colors, or mechanically by mixture of pigments, will always give a pure gray. This result is not obtained by any proportion whatever of the two colors, but only when they are mixed in a certain definite ratio, known as the saturation ratio. Incidentally, it is obvious that the saturation ratio holds good only if the colors are pure; hence there is afforded a very simple means of testing the primary colors for purity.

Ostwald's color circle is divided into 100 equal parts. If we draw the diameter joining the pair of supplementary colors yellow-blue, we find in the one half the colors yellow, orange, red, violet and ultramarine (naming them in order opposite to the usual one). In the other half will be found the blues and greens. Furthermore, the colors of each semi-circle are so arranged that the mixture of two of them will give the color that stands halfway between them on the circle.

It is obvious that there is a certain arbitrariness in this arrangement, to the extent that one might stretch out the yellows and reds to occupy a full semi-circle, rather than so stretching the blues and greens. Ostwald's distribution is obtained by giving equal parts of the circle to equal differences in wave-length, which seems to be the only method of *a priori* determination that is open; and the results indicate that it is the proper distribution.

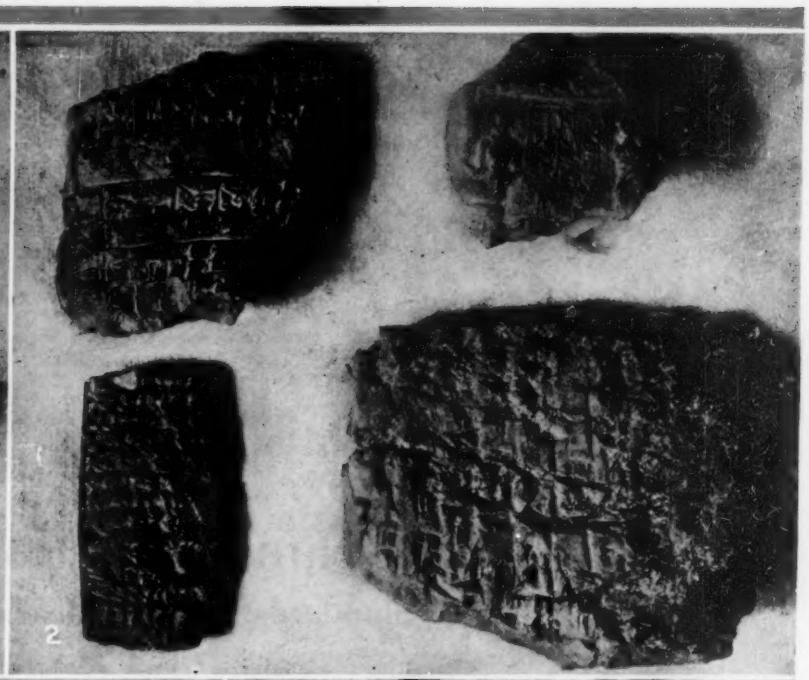
When we attempt to use the circle as a means of indexing the colors, we realize that it is continuous, while any system of indexing is discrete, necessarily. But if we take 100 shades at equal intervals around the circle, we find that these are at sufficiently small odds with one another to make, themselves, a circle that will stand before the eye as almost continuous. This selection is made, and the colors given numbers from 00 to 99. The shades from 00 to 24 then correspond to the colors ranging from sulfur yellow to cinnabar red; 25 to 49 from cinnabar red to ultramarine, 50 to 74 from ultramarine to blue green, and 75 to 99 from blue green back to sulfur yellow—again in opposite order to the usual arrangement of the spectrum.

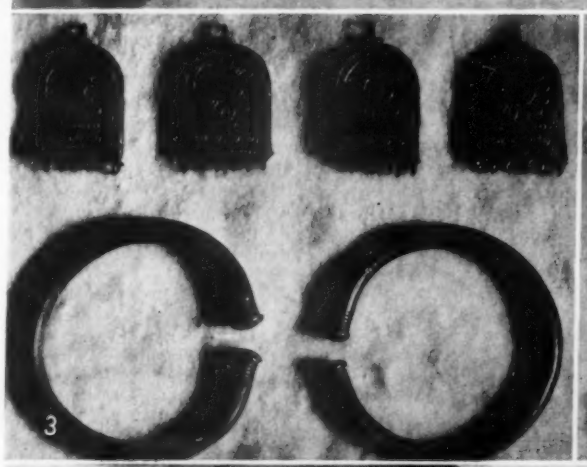
When the dull color, white, is added to any color tone, which is the pure fundamental bright color, containing no dull color, then there are obtained the light-bright colors. Any color of the color circle may be converted into a light-bright color in this manner. For instance, take a red, which has the number 21 in the color circle. The primary designation 21 means the pure color tone red. Then 21.75 would indicate the same red with a purity of 75 per cent, the remainder being white. On the other hand the pure color tone can be mixed with black; then we have a series of dark-bright colors. Similarly, when the color 21 is mixed with 25 per cent black, then the same designation 21.75 would indicate a red that is 75 per cent pure, the remainder being black. The designation is therefore incomplete, for not only must the color tone and its purity be denoted, but the nature of the impurity as well, that is, whether it is black or white or both.

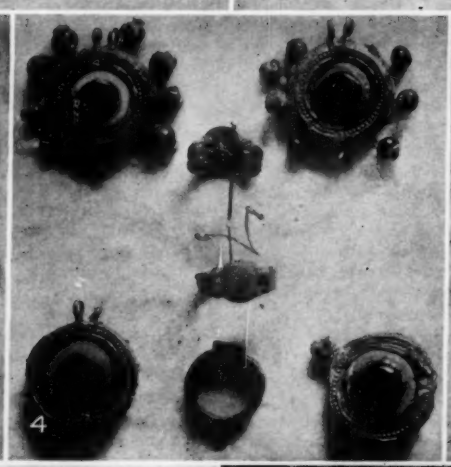
A color that contains both black and white in addition to the pure color tone is known as a turbid color. For any color therefore we have the equation: r plus w plus s equals 100, where r denotes the purity, w the percentage of white and s the percentage of black. When the color is of the clear-bright variety, then s is zero; when it is dull-bright, w is zero. When r is zero,

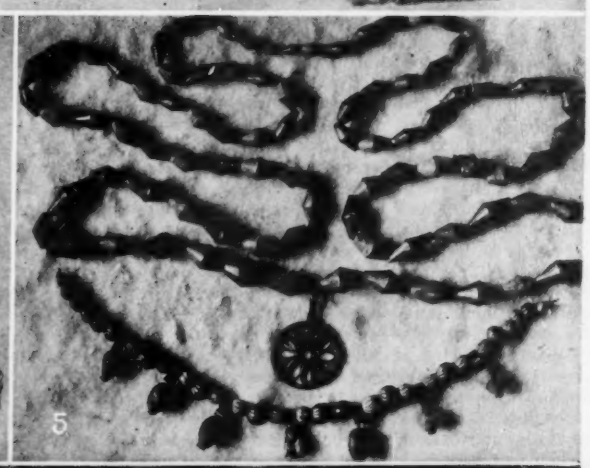
(*Continued on page 144*)

COLOR we have with us always; without it the world would indeed be drab and spiritless, and human psychology quite different from what it is. Every new theory which seeks to improve our knowledge of color, or to perfect the classification and recognition of the numerous colors, is worthy of serious consideration and study. When such a new idea is propounded by a well-known scientist like Dr. William Ostwald, the German chemist, its interest and importance are doubly certain. The numerous discussions published since he first advanced his color theory in 1917, are sufficient evidence that this theory is a contribution to our knowledge of color science, and well worth the space which Mr. Ginsberg here gives it.—THE EDITOR.









Photos, Courtesy "Illustrated London News" and the British Museum

THE excavations carried on this year by a joint expedition from the British Museum and the University Museum of Philadelphia under the leadership of Mr. C. L. Wooley, has resulted in the discovery of treasure-hoards among the ruins of the temple of the "Moon-God," which are most remarkable as showing a very highly developed civilization. Some of the remains date from 5000 B. C. The ancient city was 125 miles northwest of the Persian Gulf in the Kingdom of Iraq, which the British wrested from the Turks during the World War, thus rendering exploration possible. The spot is named Tell El-Mukayyar and some of the buildings excavated in 1919 date from 2300 B. C., or nearly 1000 years before the time of Tutankhamen.

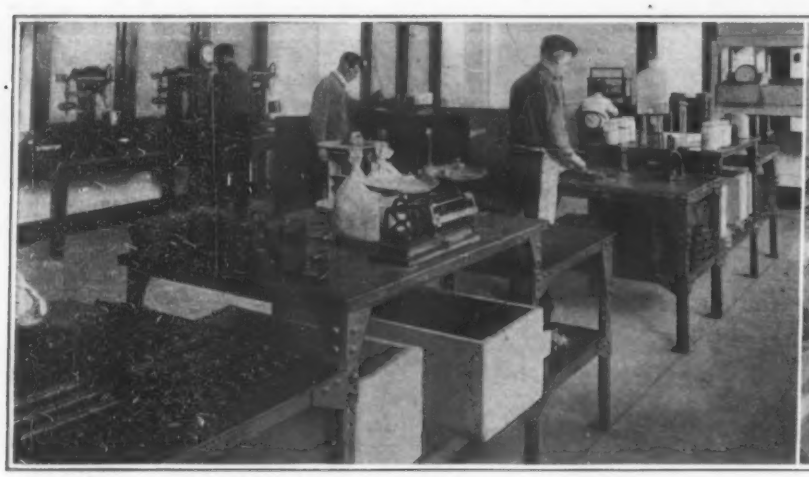
The articles of jewelry which we show (Figs. 3, 4 and 5), while of much later date, are splendid examples for the period, and we may expect to find Chaldean motives in jewelry, the same as we now have Egyptian jewelry of modern fabrication.

Chemistry has proved to be an indispensable handmaiden of archæological research here, for numerous inscribed tablets have been found, but they were in bad condition and needed careful treatment before they could be read. They were of unbaked clay and consequently very liable to crumble to pieces. Mr. Wooley applied an elaborate method of baking and treating with preservatives, so that the cuneiform inscriptions are now legible, as indicated in Figs. 1 and 2, showing the tablets before and after treatment. Most of those which have now been examined date from 2000 B. C., and relate largely to matters of money and accounts.

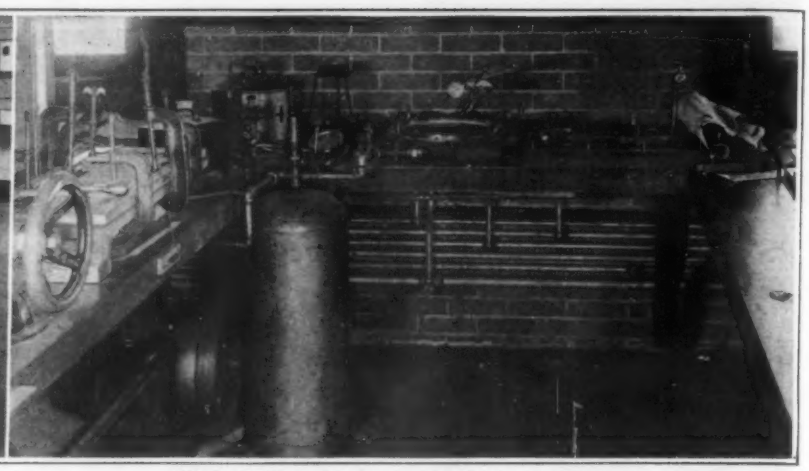
The explorations at Ur are particularly interesting because it was the birthplace of Abraham and therefore intimately bound up with early biblical history. Abraham was born about 2000 years B. C. and at that time Ur was situated on the Persian Gulf. But since that time the Euphrates has carried down enough silt to throw the ancient city far inland. It was a great maritime emporium, enjoying a large commerce. Besides, it was situated in a marvelously rich country. Chaldea was about the size of Scotland, but the "Ships of Ur" navigated all the known world. Abraham was not a Jew by birth, but was the son of Terah, an idolater. However, Abraham was chosen as the fountain head of a stream of descendants that has flowed on for 4000 years without a break. The story of Abraham in the Book of Genesis becomes very real in the light of the new discoveries. Abraham proceeded from Ur to Haran and from there to the land of Canaan.

The bottom views, Figs. 6 and 7, show part of the excavation and one of the uncovered tesselated floors.

UR OF THE CHALDEES: THE BIRTHPLACE OF ABRAHAM



The laboratory for conducting cement tests



Where balloon fabrics are tested by the Bureau

Uncle Sam's Question-and-Answer Office

The Bureau of Standards, and It's Bearing upon Everyman's Business Problems

By S. R. Winters

HOW can the dentist determine the wear and tear on false teeth; what amount of energy is absorbed by varying types of automobile tires; enumerate the different kinds of rare sugars; what temperature produces the strongest brass; how thick is molasses and what is the relation of density to quality; and how can a business man apply a motor-driven letter opener in speeding the clearance of his morning's mail?

No, this is not a list of conundrums for mere speculation or fictitious puzzles for fireside fancies. Rather, these were definite problems explored and solved recently by the National Bureau of Standards—and these are only six of 124,668 tests by actual count, more or less satisfactorily conducted during one year. By classification, 110,468 scientific observations were made for the government and 14,200 for the public. The preeminence of the demands for Uncle Sam was partially attributable to the exigencies of war. For instance, it was imperative to develop a sound-ranging device for the location of a three-inch battery, three miles away, accurate enough to fire. Civilian problems could wait solution.

Now the battle flags have been furled, the question arises how can the individual, the manufacturer, the business man, the inventor, the scientific society, public utility corporation, and the municipality avail themselves of the practical utilization of the Bureau of Standards in solving their knotty, every-day problems? Popularly termed, this government bureau is capable of applying the yardstick and the thermometer to American factories and industries—with the ultimate results of eliminating waste, facilitate precision in science, and obtain high utility in products of industry by indicating an attainable standard of quality.

Perhaps millions of American citizens have never heard of this branch of the U. S. Department of Commerce—therefore, a paragraph as to its location and organizations is not amiss.

Not altogether dissimilar to the college that chooses rural scenes for its campus as a way of removing its students from the temptations of the white lights of the city, the Bureau of Standards selected seclusion as a guarantor of freedom from mechanical disturbances and vibrations. Three and one-half miles from the White House, it is situated on a commanding promontory 350 feet from the Potomac River. It is reached by the Chevy Chase Lake car-line. Fourteen buildings, embracing 24 acres of ground, constitute its outward material equipment. The Bureau employs approximately 1000 persons, compared with 500 prior to the war.

Scientifically expressed, the Bureau of Standards classifies its function into clearly-defined divisions: Standards of measurement, standard values of constants, standards of quality, standards of mechanical performance and standards of practice. The public, however, can best visualize its capabilities and opportunities of service by briefly summarizing a few of its achievements in 1919:

States and municipalities can call upon the department to compare weights and measures. A revised edition of Circular No. 3, "Design and Testing of Standard Mass," has been published. Investigations of mine scales are being conducted in the coal fields of Ohio, West Virginia and Kentucky. Seventy-eight different railroads, in 32 states, had their railroad-track scales tested. Standards of gas service were evolved for 15 cities.

Telephone service, the bugaboo of utility commissions and public alike, is the object of extensive investigation. Street railways and electric lighting companies also bring their problems to Washington for solution. A three-wire power-distribution system was suggested and adopted by the street railway company of Wilmington, Del. Recently the Bureau was wrestling with the problem of corrosion of the lead cable sheaths of the electric company in St. Louis.

The Bureau of Standards has the only "altitude laboratory" constructed in the United States. The small room, with reinforced-concrete walls, is strong enough to withstand the pressure produced on the outside by exhausting the air within to a pressure as low as one-third atmosphere. Aviation engineers are here testing the units of mechanism operating under conditions permitting of careful scientific measurements. A device has been developed for measuring the rate of altitude on an airplane.

The Medical Service of the War Department and the general public are using 20 so-termed rare sugars. The Bureau is conducting investigations that will ultimately disclose scientific data on the rare sugars.

A controversy has arisen between buyer and seller of blackstrap molasses relative to the quality of same—the Bureau of Standards has consented to act as referee. A device for determining the density of molasses has been developed—the value of the product being predicated upon its thickness.

Hitherto the United States has imported its clay products from foreign countries. Cooperating with a potters' association in East Liverpool, Ohio, the Bureau has completed satisfactory tests whereby white-ware pottery can be made altogether from American clays under commercial conditions. Of 46 compositions, more than half proved to be satisfactory and the American housewife can use tableware made from domestic clay.

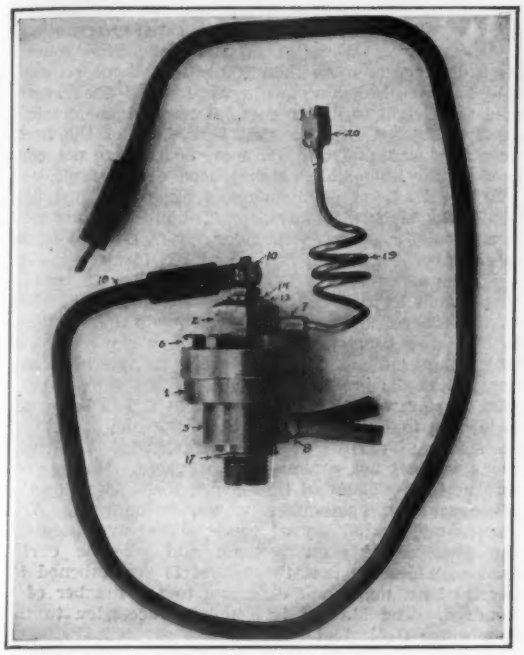
Optical glass, formerly imported from France, Germany and England, is to be manufactured on a commercial scale in this country—thanks to the efforts of the Pittsburgh laboratory of the Bureau of Standards.

Mr. Business Man, is your mail so heavy as to warrant the use of a motor-driven letter-opener? If so, write the Bureau of Standards, Pierce Mill Road, Washington, D. C., and inquire about the ingenious instrument which saves the time of an employee previously assigned to this task. The new machine is used to photograph important incoming mail, using for the purpose a motion-picture film. The photographic reference record of incoming letters, by means of a projector, is adapted to flash the image.

Dr. George Kimball Burgess has been appointed director of the Bureau of Standards, United States Department of Commerce, succeeding Dr. S. W. Stratton, who resigned the directorship to become president of the Massachusetts Institute of Technology. The new director has been identified with the Bureau of Standards for 20 years, and since 1913 has served as Chief of the Metallurgical Division.

High temperature measurements is the outstanding scientific contribution of Dr. Burgess, he being the author and translator of a number of books on this subject. His capacity for organization and leadership is responsible for the present Division of Metallurgy at the Bureau of Standards, composed of a staff of 53 persons. The newly installed director of this branch of the government service personally received the silver medal and the Bureau of Standards was the recipient of the gold medal from the Panama-Pacific Exposition of 1915. The activities of the Division of Metallurgy range from the mixing, melting and casting of, to the chemical, microscopical and physical tests of metals.

Sixteen by twenty-four inch rollers used in the metallurgical division, for studying the effects of mechanical working upon metals



1, 2: lower and upper halves of indicator body. 3: water jacket. 6: screws for holding halves together. 7: air inlet connection. 8: cooling-water inlet and outlet tubes. 10: electric terminal. 13: mica washers. 14: brass washer. 17: spark-plug gasket. 18: insulating wire. 19: small air-tube. 20: adjuster for connecting small tube to larger tube

Assembly at the spark-plug for carrying the engine pressure to the indicator

For Learning Engine Pressures

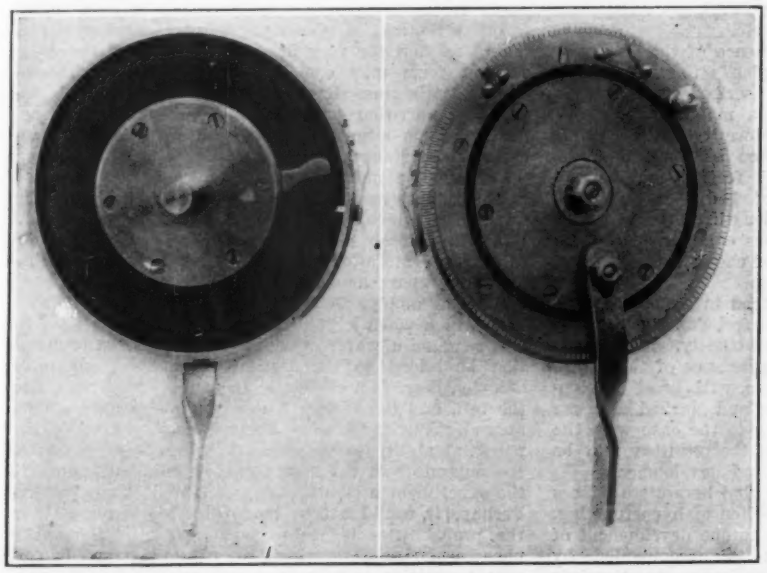
A HIGH speed indicator suitable for measuring pressures in gasoline engines or other units of mechanism where expanding gas is used has been designed by the U. S. Bureau of Standards. The device consists of three parts—the pressure balancing element, the timing element, and the coordinating apparatus.

The balancing unit contains an extremely thin metallic diaphragm, the motion of which is limited to a few thousandths of an inch by two corrugated and perforated surfaces which serve as supports for the diaphragm. The latter could not withstand the pressure without these props. The tiny space below the diaphragm is in contact with cylinder of the engine through a group of small water-cooled tubes.

The space above the diaphragm, larger than the opening below, communicates through a small tube with a source of controllable and measurable gas pressure. The center part of the upper support is replaced by an electrode which is insulated from the remainder of the indicator and is so situated that the diaphragm will form contact with it when the former is deflected up almost enough to be held from further motion by the upper support. When the pressure in the cylinder is slightly greater than the balancing pressure, the diaphragm is forced against the electrode, thereby completing the circuit and providing a positive record.

The timer is composed of a rotating contact of one-half degree and another contact which can be set at any desired angle. The coordination equipment has two parts, the electric circuit and the pressure circuit. The former is composed of a series of connection, battery, telephone receivers, timer, and indicator. The latter consists of a source of gas under pressure and a source of vacuum, with valves and gages for supplying, controlling, and measuring the pressure applied to the top of the diaphragm.

Under operating conditions, the pressure and the angular setting of the timer can be varied until the phones indicate by the ceasing or beginning of the clicking that the point has been reached where the pressure and the angle correspond to a point in the engine cycle. The pressures and corresponding angles are plotted to form the desired diagram. The indicator does not make a complete diagram for an individual cycle but is used to measure the pressures in consecutive cycles at certain consecutive points in those cycles, thereby building up an average diagram.



The single-point timer for closing the indicator circuit during but one degree of the cycle and at a predetermined position of the crankshaft

The Rivet Gun and Its Role

THE erection of a large steel skyscraper is a familiar sight to most city dwellers and all visitors to a city such as New York have been interested spectators. One of the usual sights is the delivery of hot rivets by the rivet heaters to the erectors of the steel furnace work; the rivets are usually thrown or tossed to the workmen by means of tongs and the hot rivet is caught in a tin pail or can. Such workers have become very dexterous and few rivets are lost, while accidents in which workmen on a lower level are struck by a falling rivet are so rare as to be a cause of suspicion when they do occur.

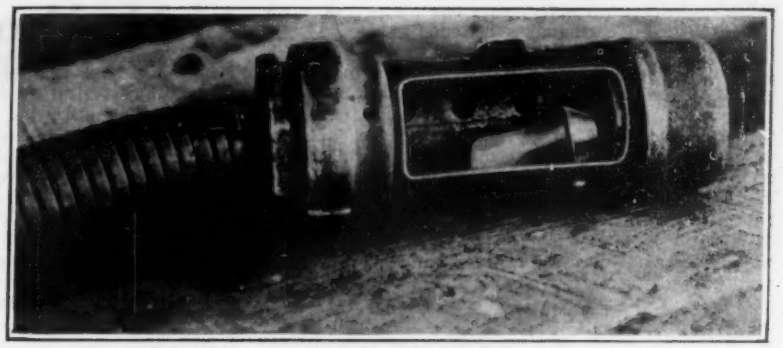
A device has been perfected, however, which does away with this cumbersome method of delivery. It is known as a "rivet gun," and with its use the hazards of rivet handling are reduced to zero.

The illustrations show the component parts of this rivet-passing outfit. They consist of a compressed air tank; a foot treadle mechanism to release the air; a compressed air inlet shown at the right side of the tank; a head or body into which the rivet is inserted; metal tubing for transmitting the hot rivets, and a receiver into which the rivets are shot at the other end.

The gun and the forge are conveniently located in an out-of-the-way place and the tubing led to the job. As each rivet is heated and ready to be passed it is set by the heater on a valve provided in an opening contained in the head of the gun. The rivet opens this valve by its own weight and enters the machine. The valve recloses automatically and the rivet is sent on its journey simply by pressing the foot treadle. The latter operation releases the compressed air, which has been supplied to the tank, into the head of the machine, and speeds the hot rivet through the flexible tubing. The rivet is shot into a receiver at the other end, where the holder-on removes it with his tongs and inserts it in the hole.

The rivet gun has a distance capacity of 125 feet delivering rivets up or down at the rate of 50 feet every three seconds. It is claimed that the gun has even exceeded this performance, shooting rivets 180 feet in nine and a fraction seconds without subjecting the rivets to any material reduction in temperature.

One of the outstanding advantages afforded by this equipment is that it eliminates the necessity of placing rivet forges in closed compartments, keeping the fires and their fumes out of closed places to the benefit not only of the riveting gang, but also of other workers there. Delivering heated rivets to points of operation difficult for direct passing facilitates work in inaccessible places and passer boys are not needed. As to air consumption, data furnished would indicate that this equipment does not materially increase the total requirements of compressed air per rivet on new construction and a substantial reduction in rivet passing costs is claimed. Prevention of a high percentage of accidents in bridge building and structural work caused by faulty rivet passing is also a feature. The equipment is particularly adaptable to building steel masts in place.



Enlarged view of the delivery end of the rivet gun

Composition, Purification and Certain Constants of Ammonia

SEVERAL years ago at the request of the refrigeration industries, the Bureau of Standards undertook an extensive investigation of the properties of anhydrous ammonia. Upon the results of this investigation will be based the compilation of accurate tables for engineers' use in designing and studying the operation of refrigerating machines.

All of the properties necessary for such a compilation have now been determined within the range of pressure and temperature ordinarily encountered in practice. The most refined physical measurements have little real value, however, unless assurance is given that the material used is of high purity. The necessary information on this point is contained in Scientific Paper No. 465 on the "Composition, Purification and Certain Constants of Ammonia," which has just been issued.

Analyses of a number of standard American brands of commercial ammonia now upon the market indicate that they are more worthy of the designation "chemically pure" than many of the more common chemical reagents. Tests conducted at this Bureau showed that most commercial ammonias contain less than 0.1 per cent of impurities.

This paper can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents a copy.

Getting rivets on the job without plucking them out of the air

A Readable Manual of Seismology

NOT until sixty years ago did earthquakes become the subject of exact investigation, and seismology is really so new a science that its treatment is not yet precisely defined. The more credit is therefore due Dr. Charles Davison for the judicious selection and orderly arrangement of material in his interesting Manual. The Macmillan Company have kindly allowed us the use of a few of the numerous interesting facts found in the work.

When the thunderous passage of an express train makes the ground tremble beneath our feet, we have a momentary sense of insecurity that, in the hypersensitive, may verge on awe. It is easy to see how violent disturbances of the crust of the earth without visible cause should have been attributed by our superstitious ancestors to supernatural agency. Priestley's attempt to trace them to an electrical origin was a failure. Even today it is impossible to say just what form the initial displacement takes, for it is masked by a mile or more of earth and rock. The seismologist takes for granted this disturbance at what he calls the "seismic focus," and studies only its effects; these are primarily a series of waves surging outward with great velocity in all directions; every particle of rock encountered is shaken rapidly to and fro, and it is this vibratory movement which reaches our consciousness. If it is sufficiently violent it may be continued up to the surface with force enough to cause a mass-displacement of the crust.

The instrument generally known as a seismograph is the pen with which the earthquake is made to write the story of its life for us to read. One of the earliest forms of this instrument was Babbage's bowl of molasses; a shock caused the fluid to climb one side of the bowl, and the position of the stain indicated roughly the direction and extent of motion. In his illuminating chapter on seismographs, Dr. Davison resolves them into their basic components, describes the way in which they work, and pictures representative instruments of today.

The vibrations accompanying even a slight shock are complex. There is usually a displacement of the ground in some definite direction, and also a rotation about some definite line; if we take three axes at right angles to one another, one vertical and the other two horizontal, the displacement may be resolved into three component displacements along these axes, and the rotation into three component rotations about the same lines. But no single seismograph capable of recording all six components has yet been devised. Fortunately, rotary movements are of slight consequence, and efforts have been concentrated on recording the horizontal and vertical movements of the ground; even here no single seismograph is sufficient; near and distant disturbances require differently constructed instruments.

Three parts are essential to the seismograph: the steady mass, a certain point or line of which remains, at least theoretically, always steady; the frame or support from which the steady mass is suspended, and which partakes of the movement of the ground; and the recorder—a lever, or a beam of light, that magnifies the displacement, and inscribes its record on a drum or plate that is usually in continuous motion. Modern instruments add a damping device, to check any oscillations that the steady mass may acquire. The principles of construction and operation are made very clear by accompanying drawings, and both mechanical and photographic methods of registration are explained.

Of the many different types of vibrations co-existing in a great earthquake, some elude our observation by reason of the smallness of their amplitude, others by the length of their period. Generally, we first become aware of a low, ominous rumbling sound; as this grows louder, faint but rapid tremors, like those caused by our hypothetical express train at not too close quarters, are felt; sound and tremors soon merge into vibrations not exceeding two or three per second, and in violent disturbances each vibration may last a second or more; deep, explosive crashes may be heard before the shock subsides and the sound dies away. A seismograph, if within the disturbed area, clearly registers the preliminary tremor, the principal portion, and the end portion, as these three phases are called. To studies of the nature and intensity of earthquake motion as revealed by seismographs are added calculations of the maximum acceleration from the overthrow of columns of known dimensions.

Some earthquakes are accompanied by noises that resemble a roaring wind, the boom of a heavy gun in the distance, the trampling of many animals, or the rending of huge masses of rock. These sound-phenomena have been duly classified and studied, and maps on which the isacoustic lines have been plotted furnish material from which significant deductions are drawn.

Most spectacular, of course, are the deformations of the crust that accompany great earthquakes. It will astonish the average reader to learn that these crustal deformations are not caused by the earthquake, but rather are themselves the cause of the shock. The Californian disaster of 1906 has been studied in the greatest detail, and the San Andreas fault traced, with three interruptions where it takes a submarine course, for a distance of more than 600 miles. Some remarkable horizontal displacements were noted that measured from eight to fifteen feet. A new trigonometrical survey disclosed the fact that both sides of the fault were displaced, and that the movements were not confined to the immediate neighborhood of the fault.

In the study of earthquakes, geographical distribution ranks high in importance. Taking area into consideration, for every earthquake felt in Great Britain there have been 50 in Japan and 158 in Greece. Indeed, the seismic map of Japan is so spotted that it looks like a leopard's skin. From such maps scientists have deduced certain laws of seismic distribution. Briefly, they conclude that earthquakes are numerous where the gradient of the surface is considerable, and rare where the gradient is small.

In these few descriptive paragraphs it has been possible only to touch upon the more popular aspects of the subject; but Dr. Davison's Manual, while eminently readable, does not confine itself to these. He sets before us the problems of the seismic focus, explains the propagation of earthquake waves, examines the frequency and periodicity of earthquakes, and discusses the relations between tectonic and volcanic earthquakes, while the text throughout is strengthened by illustrations, maps and diagrams to the number of a hundred. The Manual is a notable accession to the Cambridge Geological Series.

A Sugar-Coated Dandruff Cure

DISGUISING a dandruff cure as a man's beauty lotion for keeping the hair slicked back shiny and sleek is a new way to combat a disease that, according to Dr. Vincent Coty of Forest Hills, N. Y., is making us a nation of "head scratchers." The sufferer from this trouble will perhaps feel that it is of more importance than he had suspected when he learns that the scientific name for it is "Seborrhea Sica," which makes it appear to be a really serious matter. There are numerous theories to account for dandruff, but none have been given the seal of finality by the medical profession. Some believe it is caused by a microorganism. It is known to be more prevalent among brunettes than blondes. One remedy is resorcin and quinine in an olive oil base. This not only is a treatment for dandruff but acts as a slick for the hair as well. Many who would balk at using a preparation obviously sold as a cure for dandruff will accept the remedy if it is camouflaged as something else. Hence the growing popularity of shining and sleek hair.

Internal Secretions and Geneial Biology

THE complex operations of the organism were long supposed to be explicable wholly through the interplay of the stimulative and inhibitive actions of the nervous system; but more recently it has been discovered that an important part is played by certain chemical agents, the internal secretions. It seems quite possible, indeed, that the substances produced by the internal glands and carried to all parts of the body by the circulatory system may operate upon the same physical principle upon which is based nervous stimulation. On the other hand, it seems certain that the chemical coordinations resulting from the action of these secretions differ in some respects from those produced by the nervous system. The latter are instantaneous and often of very short duration. The former are slow, since they are the result of the action of reagents which must be carried by the blood to remote parts of the body; and continuous, since their apparent functions is the maintenance of uninterrupted relations between the various organs.

This understood, we may next inquire whether there is any generally applicable explanation of the fact that the internal secretion of a given gland exerts an effect upon some one tissue of the body rather than upon some other. For example, adrenalin, produced by the suprarenal gland, exhibits a special affinity for the sympathetic nervous system, and this affinity has actually been traced to its embryonic origin. But we also know that there are other elements having a common embryologic origin, which are later widely differentiated.

This line of thought is being pursued by numerous investigators; but there are many other paths to be followed as well. These appear to be particularly numerous and diverse when we abandon the comparatively restricted field of the higher class of mammals, and direct our attention to the internal secretions throughout the entire series of animals, and particularly to those found in the invertebrates.

The following constitute the chief preliminary facts known through study of the human case: Degeneration or absence of the thyroid gland causes profound alteration in the human form. Cretinism, a standard type of deformed idiocy, is an example of this. When the thyroid extract is administered to a cretin, the body grows taller, the bones are filled out, and the lines of the nose, eye-socket, mouth, etc., are modified so as to add intelligence to the facial aspect. Deficiency of the thyroid is also responsible for a swelling of the skin and the extremities, falling hair, etc.

Even more striking is the influence of the pituitary body, the first of the ductless glands to win general recognition. To its maladies are ascribed acromegalism and gigantism. Acromegaly is a malady whose external symptoms comprise a deformity of the skull, enlargement of the entire skeleton of the head, and change of shape in hands and feet. Gigantism is marked by abnormal height of body, an essential symptom being increase in the length of the bones of its lower portion; it also involves enlargement of the facial skeleton, forward thrust of cheek and eyebrows, curvature of the spine, etc.

Both these deformities are traced to hyper-functioning of the pituitary body. Imperfect function, on the other hand, leads to dwarfism and obesity. In the case of pituitary obesity, there is continuance of the infantile character of the external form, with great development in the layers of fatty tissue and marked decrease in size of the genitals. Contrary to the case with the thyroid, this under-functioning of the pituitary may be accompanied by normal intellectual development.

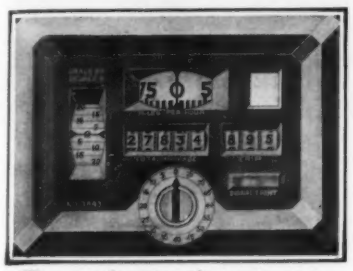
As regards the suprarenals, we find here disturbances from the normal only in the direction of hyperfunction. Premature sexual maturity with undue development of the secondary sex characters is accompanied by suprarenal tumors, which are now known to stimulate the functioning of these glands beyond the normal point. It is to be noted that in all the cases so far noted, glandular abnormality is accompanied by alteration of the sex glands in some fashion; and it is not yet certain how much of the latter is effect and how much actually cause. All the glands seem part of the same general system.

The influence of chemical substances in general upon form is, in fact, supported by many observations. The term "chemical substances" is here substituted for "inner secretions," in order to emphasize that the problem is of far greater generality than might be supposed from the special cases in which it first comes to our attention. Loeb's work in parthenogenesis has taught us that the very first impulse toward the creation of form may come from comparatively simple chemical stimulus. Experiments upon qualitatively insufficient nutrition confirm how greatly growth is dependent upon minute quantities of hitherto unknown chemical substances.

Perhaps the most remarkable phenomenon observed in this connection is the demonstrated fact that living organisms which, when left to themselves, would linger in a lower stage of development, may be made to progress into a higher stage merely by administering thyroid preparations in the form of an addition to their food supply. A case in point is that of the axoloth, which when kept in a glass bowl retains its gills and remains a water animal. But if thyroid preparation be added to the water in the bowl, the gills atrophy, there is a change in the form of the body and the tail, and the former water animal becomes a land animal. We must not overlook, however, that the potential ability to undergo this change is present in the animal from the start; else we shall attribute to the experiment a significance which it does not possess. Perhaps it would not be borrowing too strongly from the probabilities if we were to speak of the entire phenomenon as catalytic in nature.—*Abstracted from recent articles in the Revue Generale des Sciences (Paris) and Die Naturwissenschaften (Berlin).*

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



The speedometer that acts as a governor

Something New in Speedometers

POSSIBILITY of improvement in the speedometer has perhaps not impressed itself upon the average driver; but the product not being marketed by a Chicago firm indicates that this possibility exists. As far as the mechanism indicating speed, trip mileage and total mileage is concerned, this speedometer is no different from its predecessors. But it goes far beyond that.

The dial at the bottom of the instrument may be set for any desired speed, and then locked or left unlocked. In either event, as the car comes within two or three miles of the indicated speed, the signal light at the right will flash; and if the acceleration then continues until the car actually reaches the dialed speed, the ignition is cut off. If the dial has been locked, there is no escape from this; if it has been left unlocked, the driver may meet an emergency by a simple twist of the key, setting the limit forward to any desired point. Finally, the instrument may be adjusted so that the signal light alone works, without the ignition cut-out; or the cut-out alone, without the light; or both together, as described above. Ordinarily, when the ignition cut-out functions, the engine will go dead and stay dead until the car-speed falls below the dialed figure; and at this point the cut-out will go out of action and the rolling car will start the engine, just as in braking with the engine. If it is desired to prevent this, the dial may be left unlocked, and turned back to zero as the cut-out comes into action.

This suggests a further use of the apparatus as a preventive of theft. Obviously if the dial be set to zero and locked, the cut-out comes and remains in action and no spark can be obtained until the dial has been unlocked or the wiring tampered with.

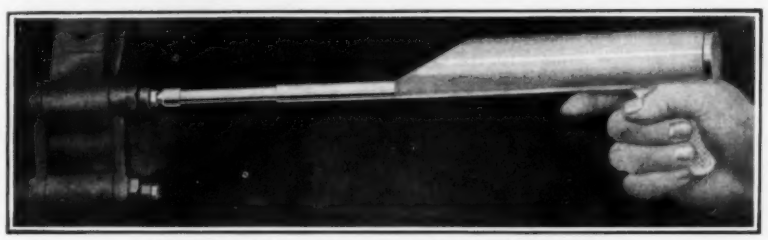
A penny-in-the-slot oasis for the thirsty fountain pen

Gravitation Truly Constant

MORE than one investigator has been led to the conclusion that the Newtonian constant of gravitation changes slightly as the attracting bodies are heated. In the Proceedings of the Royal Society for October 2, 1922, Messrs. P. E. Shaw and N. Davy, who had previously noted an increase of gravity with rise in temperature, now report that with improved suspension arrangements the difference disappears. This probably has a wider significance than would appear from its mere application in correction of the authors' previous results. The SCIENTIFIC AMERICAN has always expressed the opinion that observed variations of the gravitational constant as a function of temperature, or pressure, or of the chemical constitution of the gravitating bodies, have been due to observational errors or inadequate data.

The One-Hand Grease-Gun

LUBRICATING the automobile with one hand is the latest thing, made possible by use of the grease-gun illustrated herewith. "A ton of pressure" is the manufacturer's claim; but he does not specify whether he means total or per square inch. We assume that he means the latter, and that the true content of the claim will be duly appreciated by every prospective grease-gun user. The tool seems a decidedly usable and workmanlike affair. A single filling is said to be enough to lubricate the ordinary chassis two or three times; but just how many grease cups the "ordinary chassis" is conceded to carry is not indicated.



Reducing the grease-gun to its simplest terms

A Filling Station for Fountain Pens

WHAT do you do when your fountain pen runs dry at the most inconvenient possible moment—as it always does? If you are a student at the University of Chicago, you patronize the nearest filling station; the campus is supplied with these quite as freely as is the Lincoln Highway with filling stations for the tourist. A penny in the slot operates the machine, and enables the owner of the most voracious pen to appease the thirst of his instrument. The machine works with self-filling pens and with the old style that fills from a dropper—provided the user has his own dropper. The dropping of the coin and the turning of the handle releases ink from the reservoir, and the fluid flows into the right-hand well, whence it can be sucked up by the pen itself or by the dropper. A slot in the upper left-hand corner of the outfit contains a wiper with which any damage done by spilling or slopping may be repaired. If one drink turns out not enough, a second penny will, of course, turn the trick.

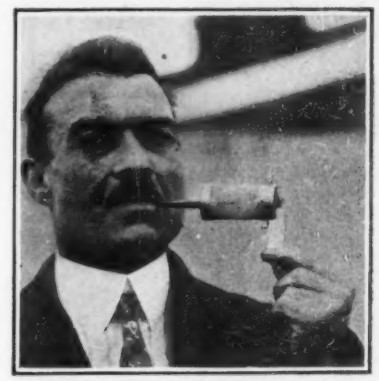
Making the Chauffeur's Cigar Harmless

WE once brought down wrath upon our head by suggesting that a cigar lighter on the dashboard of the modern automobile was not enough of an absolute necessity to justify the car manufacturer in setting it down as one of the major sales points of his latest model. The reaction of the manufacturer of the lighter was substantially to the effect that we were the only automobile owner in the world who did not smoke, and that our viewpoint was accordingly a frightfully distorted one. So we illustrate with studiously neutral comment the device that makes it possible for the chauffeur to smoke without putting out the eyes of his passengers. No, on further consideration, we withdraw this neutrality in favor of emphatic endorsement; for we have driven 100 miles beside a persistent smoker, and arrived sightless at the destination. The device illustrated consists of a gauze cylinder that is fitted about the cigar, and prevents ashes and sparks from flying about. In all seriousness, it strikes us as a highly sensible scheme.

The Normal Helium Atom and the Quantum Theory

AFTER a brief critical survey of existing quantum theory models of normal helium, a study is made by J. H. Van Vleck, in the *Philosophical Magazine* for November, 1922, of the model suggested by E. C. Kemble (*Science Abstracts*, No. 1680, 1921), in which the two electrons are arranged with axial symmetry, the one symmetrical type of which the energy had not been computed. The mathematical analysis, necessarily laborious, was rendered greater than in the case of an astronomical orbit, owing to the relatively large perturbing forces of each electron upon the orbit of the other. It occupied about six months and is reproduced in all essential details. The checking of the accuracy of the calculations by the test of constancy of the energy of the system, commonly used in the astronomical case, would here have involved the extremely laborious calculation of the coefficients of the various periodic terms of the Fourier expansions of the kinetic and potential energies. A much easier method was furnished by the fact that in motion under the inverse square law the average absolute value of the potential energy is twice the average kinetic energy. Since the average value is simply the constant part of the Fourier expansion, and since a power series development is unique, the coefficients of like powers of the parameter must be identical if the computations are correct. There is absolute agreement in the first three terms, while the small errors in the fifth decimal place in later terms are insignificant, and due mostly to neglect of the third and higher powers of the perturbations. The model is a sort of hybrid of the Bohr and Langmuir models. It may be approximately described as the projection of a sine curve on a barrel-shaped surface of revolution, the two electrons always being on opposite sides of the barrel.

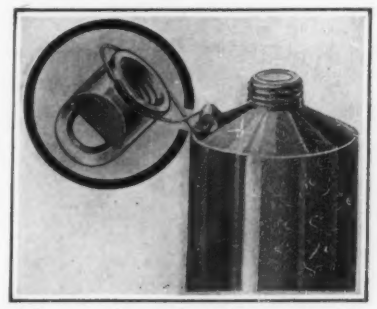
The chemical stability of helium indicates a very simple and symmetrical arrangement of its pair of electrons, but all the models possessing this property now appear to have been tried and found wanting. A reformulation of the quantum conditions is one alternative and the author considers several of such. But he finds each one precluded by incompatibility with experimental results. A. H. Compton (*Science Abstracts*, 908, 1921) concludes that the spiral tracks of beta particles indicate the field of an electron not having the spherical symmetry required by Coulomb's law, and he suggests the beta particle acting as a magnetic doublet as well as an electric charge, but if the helium electrons did so act, their strength, to reconcile the calculated ionization potential of the model, would be quite incompatible with observed molecular magnetic moments and would invalidate the classical theory of X-ray scattering. Crowther and Schonland (*Science Abstracts*, 1320, 1922) suggest that some modification of the law of force at *very small distances*, either between two negative electrons or an electron and a nucleus, appears to be demanded by their experiments in the scattering of beta particles.



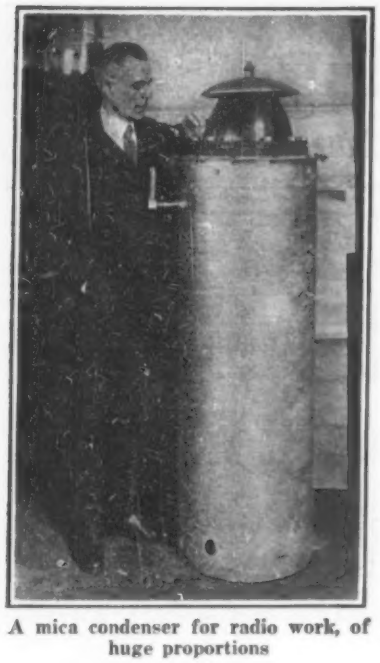
Safety for the person who has to ride with a smoker is secured by this gauze cage for the cigar

The Cap that Can't Lose Itself

THE proverbial collar button may still take first prize as a champion in losing itself under the dresser, but the cap of the tube of shaving cream has made a rival record as one of "life's little irritations" by its disappearances



The cap that is bound to stay with its tube



A mica condenser for radio work, of huge proportions

down the lavatory outlet. Man had to devise something better to save his temper and the result is that the manufacturer of one brand of this daily toilet necessity has put it into a tube whose screw cap is hinged as well. You can't lose it unless you mislay the entire tube. For further convenience the cap is designed so that it may be hung upon the wall by a little screw hook which accompanies it.

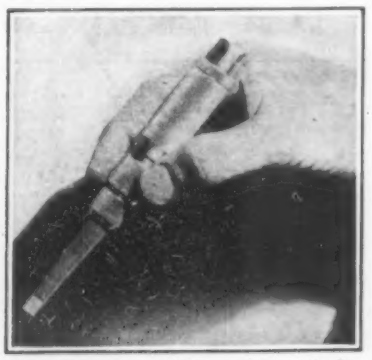
The Lightning Change Screwdriver

THE question of having the right tool at the right time has been partially solved by a western manufacturer who has produced the very ingenious magazine screwdriver illustrated.

It is absolutely a new idea and a departure from the usual magazine screwdriver in that the blades issue from the chuck into the working position without leaving the magazine. It contains three sizes of blades that are designed to give it a wide range of use. The blades are always contained within the magazine and are not removed, consequently they are not lost or misplaced as is the case with most magazine screwdrivers.

The basic principle of this new tool is that the blades are selected and issued by gravity, by tipping the tool. The blades are indexed to correspond with numbers on the shell, and the operator is always sure of getting the right blade by simply holding the desired number up when tipping the tool as indicated in the illustration.

This new tool will be found useful by mechanics, machinists, carpenters, sportsmen, electricians, automobile owners, and in fact anyone who ever uses a screwdriver.



Magazine screwdriver with a foolproof gear-shift

A Giant Condenser

SO far as is known, the single-unit mica condenser illustrated herewith is the largest in the world. It has just been completed by the manufacturer for use in one of the Government radio stations. It has a capacity of .0025 microfarad at 90,000 volts with 1855 kva. It is of the oil-immersion type. The top insulator is of porcelain and the high tension terminal projects from it.

Condensers of this general type have been made by this New York concern for some time, but the one shown is the first of its size to be manufactured. Similar condensers will shortly be in extensive use in connection with power-factor correction, for lightning protection, and for other uses. Recent reports are that the installation of this condenser has increased the station efficiency by 10 per cent.

By way of comparison, the gentleman standing at the condenser holds in his hand one of the same company's condensers as ordinarily employed in radio receiving. As may well be imagined, the enormous difference in size introduces manufacturing problems that are by no means easy to meet.

Can-Openers of the Month

TRADITION has the lock nut and the garment snap as constituting the most fruitful field for invention, when measured in mere numbers of patents. We have expressed at one time or another a suspicion that the monkey wrench and the combination utility tool were close competitors; and it just dawns upon us that another implement in which the scope afforded to ingenuity practically without limit, is the can-opener. We illustrate the remark with two examples.

One of these, at the expense of a little more space than is usually taken up by the can-opener, does what we have not seen done before—it actually holds the can while it opens it. This in a way supersedes the safety can-opener, because

The non-skid can-opener

the only reason why the average housewife cuts herself on the can is that the latter slips in her hand. In addition, this opener cuts the whole top off clean, leaving a smoothly turned edge. A left-hand turn of the crank opens the machine for insertion of a can, and a right-hand turn performs the decapitation. The apparatus occupies space—but no more than the less-used meat chopper.

For cans of fluid, every user knows that actually removing the top is unnecessary; that two holes punched in the top, one for the entrance of air and one for the exit of the contents, are quite sufficient. With special reference to canned milk, we are now offered a simple device for punching the two holes at the most advantageous spacing.

An Outside Micrometer with No Moving Parts

THE latest micrometer instrument is of a steel tape design. It measures diameters from 2⅝ to 5 inches by thousandths of an inch. It does the work of a micrometer caliper, though instead of reading decimals, it gives direct reading in thousands and fractions thereof. For instance, if an article should measure 3.3175 by the micrometer caliper, this instrument will give a direct reading of 3 5/16 plus five thousandths. This is mighty handy to the mechanic, who is not well versed in decimals. The graduations are quite legible as they are about one-eighth of an inch apart. This is possible, because while they represent diameter measurements, they stand on the circumference, and hence are more than three times as far apart as the corresponding marks on an ordinary straight rule would be. The tape is wrapped tightly around the object with the two scales abutting each other. The one piece construction eliminates faulty adjustments. Being so compact it may be easily carried in the kit or pocket, and requires no adjustment in use.

The easiest way to get into a milk can

Plating with Cobalt

PROBABLY the newest development in electroplating is the deposition of cobalt. Recently announcement was made of the discovery of a new process for electroplating with chromium, but the cobalt development is still more recent. A few years ago some Canadian research workers in the Canadian Department for Mines created considerable interest by putting forward a proposal to use cobalt as a metal for electroplating in the place of nickel. The results of these researches showed that cobalt could be deposited on brass, iron, steel, copper, tin, German silver, lead and Britannia metal, and that the deposits were firm, adherent, hard and uniform, and could be readily polished to a satisfactorily finished surface. The cobalt deposited was harder than the nickel and the speed of deposition considerably greater. It was also claimed that its resistance to corrosion was definitely superior to that of nickel, and that the deposits stood satisfactorily all the usual bending, hammering and burnishing tests. The actual weight of cobalt required for a good coating was stated to be about a quarter that of nickel. It is possible to electroplate with cobalt quite satisfactorily and very rapidly, but it is unlikely that cobalt will ever attain the industrial importance of nickel.

Better Picture Frames Through a New Vise

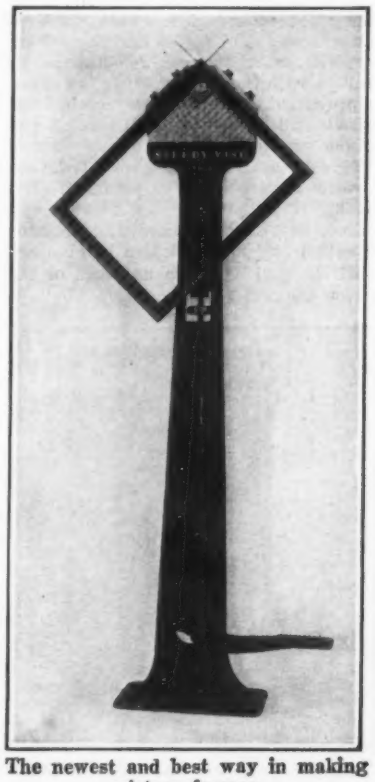
THE heavy old-fashioned picture frames may have passed away, but there are thousands of smaller frames being sold to the hundred of the old style frames. In art shops the making of picture frames is a large part of the business and the frames going through are ranging in size from those to carry post cards and smaller mottoes to some that are several feet in each dimension, and the molding used varies from a fraction of an inch in thickness to several inches. The volume of the business requires maximum speed, especially since

New and ingenious idea in the micrometer field

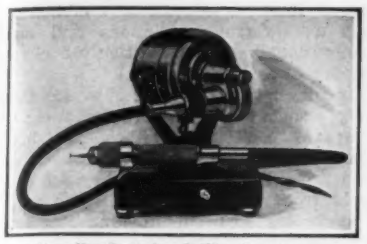
the prices do not justify high costs. In nailing the smaller moldings there is more danger of ruining the job or putting the corners together in unsatisfactory way than there is in making the frames of the larger molding.

During the war one art dealer had to use so many green employees that he invented a special vise that enabled a green girl with little practice in driving a nail to turn out in a half day more work than several experienced men would complete in a day, and do the work more satisfactorily. He realized that the danger point was in driving the nails for the corners, so his vise was arranged to handle that part of the work.

A set screw in the standard brings the under gripper of the vise to a position where by stepping on the pedal the frame is held between this gripper and the two rests with the angle of the frame open for nailing operations. Some of the advantages of the vise as proved by its inventor's experience are that the frame is held rigid and the operator has both hands free; this removing the necessity for nail-setting. Nor are there holes to drill. No operations for the hands are necessary, the feet performing the operations that grab the frame. Cross-nailing, one of the "ticklish" phases of frame-making, is easily done without turning the frame. Small frames as well as large ones and small molding as well as molding two inches wide can be handled. It has helped this dealer to put frames on the market to meet a popular price demand.



The newest and best way in making picture frames

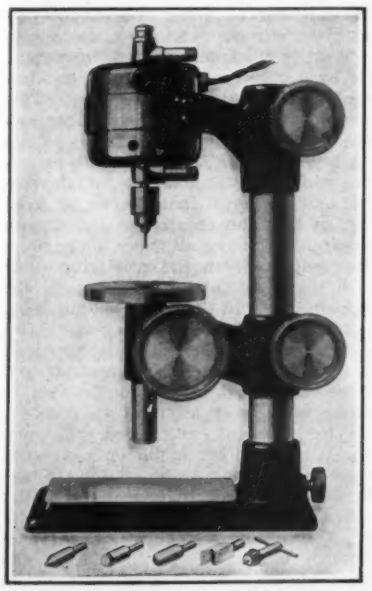


Small electric drill of extreme sensitivity

Electric Drills and Utility Tools

THE range of electric drilling and general utility tools is amply demonstrated by the two units which are illustrated at the top and bottom of this column. At the top is a machine designed to fill the demand for a bench drill that could be depended upon for absolute accuracy and extreme sensitiveness. At the same time it is adaptable enough to be used on many kinds of work. The motor is dynamically balanced, and runs equally on direct or alternating current. A ball thrust bearing takes up all end play, and wicked grease cups insure positive lubrication. Perfect concentricity in the drill is had by carefully grinding the gripping joints of the chuck jaws. Quick-acting locking devices make the raising and lowering of the motor or work-table a simple operation. The work-table is rack-and-pinion operated, and easily controlled by the operator's hand. A depth-gage regulated by a thumb-screw prevents the drill's going too deep. The balance of the table and its gearing is such as to bring drill breakage to a minimum, with the smallest and most delicate drills. "Perfect control, ease of operation, and unusual adaptability" are the claims made for this machine, apparently with good reason.

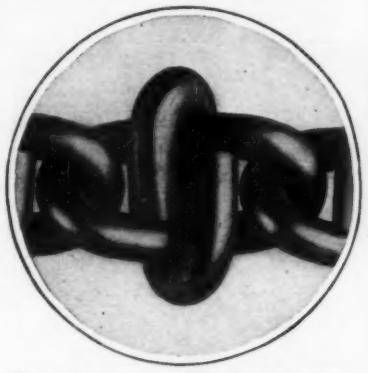
The general utility tool illustrated below is produced by the same manufacturers. The motor speed is reduced through a worm-and-gear drive that assures ample torque. Particular attention is called to the hand-piece, fitted with a double-row ball-bearing that takes up all thrust and radial load. The chuck will hold tools from one-eighth inch down to No. 80 drill. Its speed is from 500 to 2000 revolutions per minute, controlled by a five-speed rheostat. The chuck guard, which permits gripping the hand-piece close to the work, can be removed with a single turn. All together, this tool seems a fair match for its brother in efficiency and all-around adaptability.



The electric jack-of-all-tools

Better Tire Chains for Next Winter

AMONG the things that every automobilist knows are the comparatively short life of the cross links of anti-skid chains, and the unsatisfactory action of the clips that hold the side chains together. Especially if one is obliged to drive over alternating stretches of country road and concrete, the former being in such shape as to demand chains while the latter is substantially clear, one finds that the chains do not stand the gaff. Replacable cross links, while conserving the undamaged side chains, are really a begging of the question. And who has not had to stop in dirty weather to unwind a chain from the axle, about which it has been permitted to fall and entwine itself by the opening of one of the clips?



New style of cross link that gives longer life to tire chains

We illustrate herewith the latest devices of the chain makers to overcome these drawbacks. The new style of link offers a far greater amount of metal to the road at a given instant, and hence should last far longer. And the new clip not alone closes and locks more positively than its predecessor, it also makes it easier to bring together within clipping distance the two ends of a chain that is just a finger's breadth too short to go around the tire easily. This latter advantage, however, is a collateral one beside the positive locking feature; it will be plain that the clip actually hooks around itself, instead of depending upon surface friction or spring tension to hold it closed.

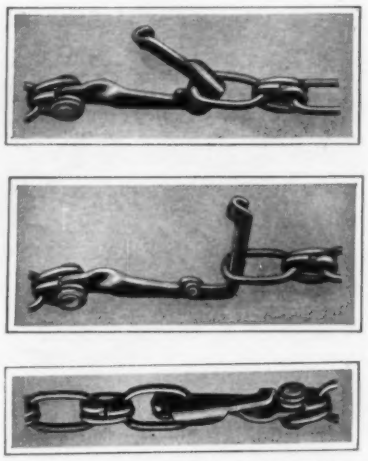
Motion of a Sphere in a Rotating Liquid

A SPHERE of uniform density is supposed to be suspended in a uniformly rotating liquid of the same density. An initial relative motion of the sphere parallel to the axis of rotation is set up by an instantaneous impulse sufficient only to effect a small disturbance in the motion of the system, small motion being defined to be such that the squares and products of velocity and vorticity components may be neglected in the expressions for acceleration. The initial disturbed motion of the liquid will then be irrotational, since the effects of rotation take time to develop. Now the pressure intensity of the liquid consists of two parts, one depending only on the distance from the axis, and the other on the disturbed motion. When the disturbance causes the sphere to move parallel to the axis of rotation, the disturbed motion of the liquid will continue symmetrical about a line through the center of the sphere parallel to this axis, and the motion pressure of the liquid will also be symmetrical about this line. The resultant effect on the sphere will, therefore, be to produce an acceleration parallel to the axis of rotation, causing the sphere to continue its motion parallel to the axis of rotation, and its line of relative motion may be called the axis of the sphere.

It is found most convenient to assume the existence of this particular type of motion, and then to show that all the conditions can be satisfied by making it a particular function of the time, a perfectly definite mathematical problem, the solution of which gives the following results: The sphere oscillates about a point on its axis, the distance of which from the initial position of the center of the sphere is proportional to the velocity of projection; the amplitude of oscillations rapidly approaches zero, but the period approaches a constant value half that of the undisturbed rotation of the liquid. A general expression is obtained for the velocity, at any point, reducing to simple expressions in particular cases, which are examined in the paper. It appears, however, that the gradients of the velocity of the liquid over the equatorial plane of the sphere and of the transverse velocity along a meridian of the sphere ultimately increase without limit, a stage being reached after which vorticity components cannot be considered small, so that the solution will represent the true state of the liquid only for a limited time. The question of the ultimate physical state thus remains unanswered. J. Proudman has shown that a small steady disturbance is impossible, but G. I. Taylor obtained a solution of the general equations of steady symmetrical motion about a sphere, which does not satisfy the equations of small motion.—*Science Abstracts, 626, 1923, based on paper by S. F. Grace, Proceedings of the Royal Society, 102, pages 89-111.*

Research on Edible Gelatin

ANNOUNCEMENT is made of the establishment of a Fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh,

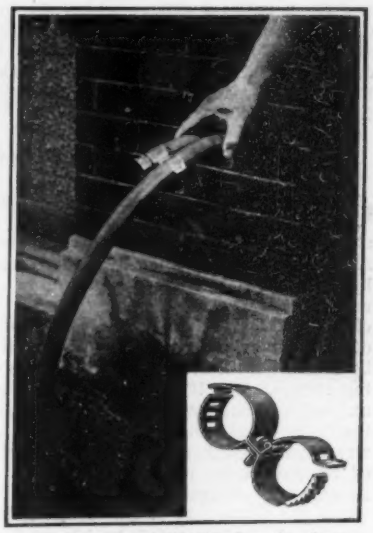


Partly open, open and closed positions of the new chain clip that hooks positively instead of depending upon friction to keep it closed

for the purpose of ascertaining the real food value of edible gelatin in its manifold applications in the American dietary.

The founding of this Fellowship is the outgrowth of the desire of the gelatin manufacturers to uphold high standards in the manufacture of this food and to have available for their own use and for the trade data of scientific and technical nature respecting its advantageous use in the food industries.

In addition to experimental investigations, a correlation of all available facts regarding edible gelatin will be made, to be held at the disposal of all users and prospective users of the product. The present incumbent of the Industrial Fellowship is Dr. Thomas B. Downey, who will be glad to furnish any available information to those interested in the uses of edible gelatin.



The newest substitute for the hose reel

Exit the Hose-Reel

SOMETHING far simpler than the hose reel is offered the amateur gardener in the clip illustrated herewith. For moderate lengths of hose, much less space is occupied by a hose looped on itself once like a hoop, fastened by the clip, and hung on a peg, than by one reeled up in the old-fashioned manner.

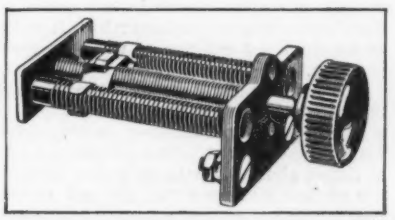
Periodic Annual Variation in Pendulum Rate

COMPTES RENDUS, 175, pages 748-750, gives an account by R. Goudey of observations on a pendulum in the Besancon Observatory. This pendulum is in a ground-floor room, enclosed in a double glass case; so that the temperature varies slowly, but variations of atmospheric pressure are felt. It appears that each year this pendulum runs slow beginning about April 11; that from that date until September 11 there is a series of rather indefinite fluctuations; and that, subsequently, the pendulum moves at its mean rate until near the end of the year. The movements have been established by curves plotted for twelve different years; they cannot be explained by changes either in temperature or in pressure, or as the result of chance. Whether they are a peculiarity of this pendulum, or may be looked for in other instruments, does not appear.

A More Sensitive Radio Rheostat

RECENTLY there was placed on the market a radio rheostat with greater automatic features than have been offered heretofore. It gives the most precise control of filament current, inasmuch as the range which is covered by three-quarters of a turn to three complete turns on most instruments, is here spread out over 40 full turns of the knob. This does away with all necessity for hair's breadth adjustments.

Two parallel-mounted, wire-wound, fire-proof resistance tubes are connected in series by a micrometer-operated slider, the length of wire in the circuit depending upon the location of this slider. At "full on" position the device possesses practically zero resistance, and



Radio resistance member that requires no minute adjustments

it gives a uniform change with each full turn of the knob, right up to its maximum. One full turn of this knob, it is claimed, yields a finer adjustment than the "hair's breadth" change on the more familiar rheostats.

A Flexible Ruler for Drawing Curves

ONE of the most ingenious drawing instruments that we have seen is shown to us by a German inventor, Walter Arndt, of Dresden. This, by direct translation of its formidable German name, is seen to be a flexible curve ruler with changeable curves. It is, in all details of appearance, just like the stencils used by draftsmen all over the world for drawing curves. But it is made of a pliable and elastic material, so that within due limits, it can be bent further around, or straightened further out, to give a series of related curves of varying degrees of flatness or sharpness. The degree to which the shape may be changed, without causing the instrument to buckle up from the flat surface of the drawing, is indeed surprising—Herr Arndt has sent us samples and we have verified this for ourselves. Yet it is stiff enough to hold its shape against the pencil pressure.

Ohm's Law at High Field Strengths

IT is customary to regard the motion of electrolytic ions as very slow, and the author investigates the problem as to whether the velocity will grow proportionately to the force for much stronger fields than those usually employed, *i. e.*, does Ohm's law still hold valid. Lenard from kinetic considerations concludes that for field strengths of 10^6-volt/cm., deviations occur for the H ion, which quickly grow according to the square of the field strength. The author is of the opinion that our meager knowledge of liquid constitution demands an experimental proof for Lenard's conclusions; hence the present investigation. The difficulties attending the measurement of the resistance in such high fields (100,000-volt/cm.) are considered, and the method of surmounting them given in detail. The paper contains several diagrams of apparatus and data curves. The solutions employed for the measurements were of sodium chloride, sulfuric acid, and sodium chloride containing 47 per cent of cane-sugar, with which to increase the internal friction of the solvent. From the results obtained the author concludes that up to field strengths of about 500,000-volt/cm. Ohm's law remains valid only up to 1 per cent, and he claims to have established a qualitative confirmation of the Lenard theory. —*Science Abstracts, based on paper of M. Wien, Physicalische Zeitung, 23.*

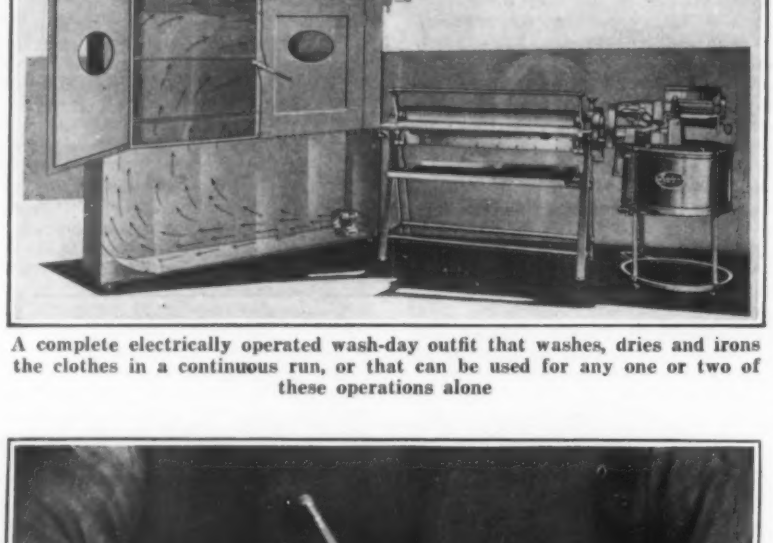
The Electrified Wash-Day

MONDAY and Tuesday will lose much of their terror for the housewife through the more general adoption of washing, drying and ironing machinery; and a typical example of what inventors are doing in this field is shown on this page. This assembly is designed to operate on the continuous-run principle. One garment at a time passes through it. While the second article is in the drying cabinet, the housewife has time to put the third one in the washer and run the first through the ironer; and so on to the end of the family wash. The machine is more largely manually directed than some of the better known washers; but it calls at no stage for the use of the operator's strength.

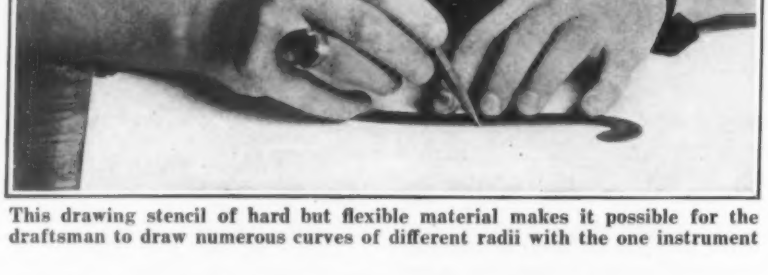
The dryer is so constructed that the air is heated, immediately before intake, by a gas heater and radiator; or electricity may be substituted. The dry heated air is forced along the bottom, rising through the clothes and near the left end to the top, whence it is again forced downward through the remaining clothes by the hot-air agitator, operated by its own motor from a light socket. This combination gives a powerful, continuous and uniformly distributed circulation of clean, hot, dry air.

This dryer overcomes one objection that many women have to clothes dryers; it does not "cook" the clothes, but dries them quickly and evenly and bleaches them properly. In addition they are protected from smoke and dust. The drier is again useful in disinfecting clothing, blankets, furs, and the like, ridding them of moth, etc. The gas heater in the dryer may also be used for heating hot water.

The ironer, electrically operated, is fitted out with two rolls, rather than one, which permits much better adjustment of the rolls and the work in relation to the heat. It carries a stationary foot-table, giving the operator a place to work on when straightening out, taking back, feeding in, or changing anything that is about to enter the machine. The receiving tray is of galvanized sheet steel, heavily enamelled, and is entirely sanitary. All the gears are enclosed. The washer is operated electrically, and is similar to those on the market. Either of the three units may be separately operated.

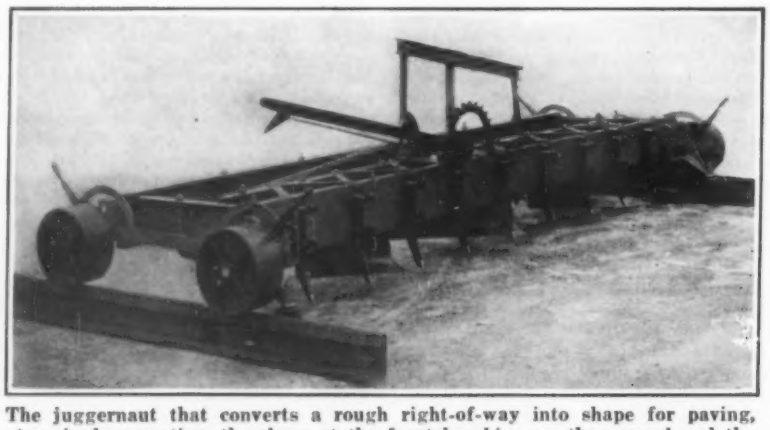


A complete electrically operated wash-day outfit that washes, dries and irons the clothes in a continuous run, or that can be used for any one or two of these operations alone



This drawing stencil of hard but flexible material makes it possible for the draftsman to draw numerous curves of different radii with the one instrument

Ruler, protractor, T-square and compass are combined in one tool by this ingenious device



The juggernaut that converts a rough right-of-way into shape for paving, at a single operation, the claws at the front breaking up the ground and the blades at the rear making a finished job of the grading

Four Draftsman's Tools in One

THE draftsman in the third photograph on this page is using a single instrument that takes the place of four. The circular part under his hand is obviously a protractor. The straight part between his hands is with equal clearness a ruler. The possibility of using the instrument as a T-square is self-evident. And the user is shown getting out of it the service ordinarily rendered by the compass.

This is effected by a simple device. The draftsman's left hand is shown grasping a little pivot point which can be securely attached in the angle of the T, and in such fashion that the point itself, piercing the board on the under side, is exactly in line with the scale along that side of the ruler. An adjustable slide moves up and down upon the ruler, carrying a little ear that projects across the ruler's edge, and that is provided with a hole for the pencil point. Thrust through this, the pencil lines up along the ruler edge with the pivot point. In this way an accurate radius may be struck; and the swinging of the arc follows easily. Incidentally, the zero point on the protractor is also in line with the pivot point and the pencil point, enabling the user to pivot the instrument and lay out angles with extreme ease and speed.

A Giant Plane for Subgrading Our Roads

THE business-like fashion in which the road-maker of today goes about preparing the site on which he is to lay his pavement is put before the eye in graphic style by a glance at the sub-grader illustrated at the bottom of the page. This machine is such a big, heavy affair and takes such a huge bite that it has to run on a temporary rail. The rail is in sections, which are taken up behind the machine and put down immediately in front of it, so that the requirement of smooth trackage does not at all delay the game.

In front are seen the scarifying teeth which start the job of breaking up the subgrade. Behind them, less plainly seen, are the big blades that finish it. After the subgrader has passed, the subgrade is left planed off to the exact depth desired for the laying of the road slab. The blades can be very finely adjusted to take exactly the depth of cut desired. The machine will cut either a flat or a crowned subgrade, and can also be set for the new Illinois design of road, calling for a thicker slab at the edges than in the middle. A turntable pedestal allows the machine to be raised off the forms and turned edgeways in the middle of the road to permit the roller or trucks to pass.

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Electricity to Be Generated From Dry Gas

AFTER the gasoline is recovered from casing-head gas, there remains a product, known as dry gas. Recently the Government authorized one of the large operating companies of the mid-West to utilize the dry gas for the generation of electricity, which is then used in running the well pumps. The use of dry gas for this purpose is intended to reduce the cost of well operation as well as increase the output of the well.

New Paper Stock: Cypress Pine

THE West Australian Forest Products Laboratory has announced that the wood of the cypress pine, a tree which is indigenous to Queensland, is suited for the manufacturing of paper. The paper is brown in color and is claimed to be superior to that obtained from the hoop pine and silky oak, two recent developments brought forward by the same laboratory. In fact the cypress pine paper is said to be lighter, thicker and stronger than imported Kraft paper. It has also been found that the silky elm or brown oak of the coastal forest is almost equal in value to the cypress pine.

Preservation of Fish Nets

ACCORDING to the United States Bureau of Fisheries the efficacious methods of preserving fish nets are tanning, tarring and creosoting. In the tanning method the nets are left soft and pliable. After the nets have been dipped into the tan liquor it is well to give them a treatment with bichromate of potash, which increases the preservative powers of the tanning materials, such as quercitron, catachu, gambier, etc. Hemp threads are afforded protection in this way as well as cotton threads but not to so high a degree. Tarring the nets is the principal method used in the United States. It consists simply of passing the nets through hot tar, removing the excess tar and then partially drying. This is a very effective method as the coal tar used is an antidote against putrefaction. Creosote oil is also used for preserving nets. It is a good preservative and causes little shrinkage. The principal objection to its use is that it washes out too readily, or evaporates from the net.

Gasoline From Coal

ACCORDING to experiments that have been made in Mannheim, Germany, the Germans have succeeded in making gasoline from coal. A report from the American Consular Service indicates that a plant has been established for making about 60 tons of gasoline a day from coal. The conversion of the coal into gasoline is accomplished by hydrogenating the coal, whereby its chemical nature is changed. About 90 per cent of the coal is thus converted into a liquid which is similar to fuel oil in its chemistry and fuel value.

Belt Dressing From Old Rubber

OLD rubber, worn out inner tubes and the like may be used in a composition, employed as a belt dressing and pulley cover. The rubber is first cut up into small pieces and then heated in an ordinary kettle to the desired temperature. The heat reduces the rubber to the liquid condition. Old rubber, which has been subjected to more or less oxidation due to exposure to air, is used preferably, as it produces a superior product. Old rubber which contains such substances as zinc oxide, sulfate of barium, lampblack, etc., gives good results.

A thick, heavy liquid substance is produced by the fusing process, which is no longer rubber but which is of very heavy consistency, highly adhesive, of a waterproofing nature and capable of adhering strongly to surfaces and of forming a frictional coating on them.

New Protective Agent for Animal Fibers

ANIMAL fibers, such as wool, silk and substances such as leather and skins are protected against the action of alkalies in their finishing and treatment processes by means of a product, known as Protektol, which is prepared from sulfite cellulose waste liquors. This represents just another way in which these liquors can be put to good use. For further details the reader is referred to the *Deutsches Woolengewerbe*, Vol. 54, page 1551.

Making Artificial Egg Substance

A SUBSTITUTE for white of egg and yellow of egg is made from fish roe, according to a German process, which is patented in German Patent No. 342,308. The roe is first extracted with fat and lecithin solvents, such as alcohol and ether, and then after the solvents have been removed by evaporation, the substances remaining are treated with a hydrating agent until they take on the odor of egg yellow. This mass is then mixed with protein substances or the protein residues obtained in the extraction of the fish roe. Palladium, precipitated on very finely pulverized infusorial earth, is used as a catalyst in the hydration. About 40 kilograms of egg substitute can be obtained from 100 kilograms of codfish roe.

Durable Stain for Woodwork

A NEW German patent, which describes a process for making a durable stain for woodwork is as follows: A solution of one kilogram of commercial deep brown stain (Cassel brown, consisting chiefly of alkali humates) in 30 to 40 parts of water is filtered and heated to boiling, and about five liters of a two per cent solution of ferric chloride are stirred in, in a thin stream, until the mixture will filter easily and the filtrate shows an excess of iron. After decanting as much of the liquor as possible the remainder is passed through a bag filter, and the solid residue is dried on porous clay plates, or in a vacuum, until the paste, mixed with a little ammonia, forms a stain ready for use. This stain soaks well into the wood, and on evaporation of the ammonia becomes insoluble through the decomposition of the complex ferro-ammonium compound of humic acid.

Metal Linings by the Spray Process

THE spraying of metals on surfaces in order to produce metallic coverings is not a new process, but to the present time it has not given the most successful results. The coatings that have been obtained hitherto have been of a porous character, which is a decidedly undesirable property in resistant linings for chemical apparatus. It is now claimed by the German company, known as Metallisator A. G. of Altona that thoroughly satisfactory tin, lead, aluminum and copper linings can be produced on iron by subjecting the sprayed metal coat to a finishing process, which may be either mechanical or chemical or both. The lining may be rendered more coherent by hammering. The pores may also be filled up with some chemically resistant material, for example, in the case of lead lining with lead sulfate obtained by treating the lining with sulfuric acid. The great advantage of these sprayed linings over the usual laid-on ones lies in their close contact with the underlying material, which is an important factor in apparatus with walls through which heat is to be transferred. —*Chemiker Zeitung*, Jan. 11, 1923.

New Oil Seed From Gold Coast

THE nut known as Kisidwe can be used to good advantage as an oil seed. The oil content is about 44.2 per cent of the entire weight of the nut. The fat could probably be used as food and in the manufacture of soap. The removal of the shell, which is thin and which forms only about 38 per cent of the weight of the nut, should not present any difficulty. The residual mass, after the extraction of the oil, possesses a bitter taste due to the tannin contained in it, and hence is unsuitable for cattle food.—*Bulletin Imperial Institute*, XX, No. 4, 1922.

Building Stone From Castor Bean Refuse

IN England a building stone for interior purposes is made from the refuse that is recovered from the extraction of castor oil from the castor bean.

Asphalt Vapors a Moth Killer

TESTS have been made in Germany to determine the effectiveness of asphalt fumes as a moth killer. The asphalt is vaporized by being heated in an enameled pot and the vapors are allowed to enter a well-closed room, where they exert their destructive action on the moths.

Sulfur Dioxide from Sulfates

WHEN alkaline earth sulfates, such as sulfate of magnesia, lime and strontium are mixed with iron and then heated to the proper temperature, the sulfate is decomposed by the iron with the evolution of sulfur dioxide gas. This reaction is generally carried out with the aid of carbon, and in this case, where iron supplants carbon, the reaction can be effected at a considerably lower temperature and also with a better yield of sulfur dioxide gas. This process is described in detail in the German publication entitled *Zeitschrift fuer angewandte Chemie*, volume 125, pages 337-348.

Uses of Zinc Dust

AN interesting list of the uses of zinc dust in the powdered state is quoted in a recent issue of *Chemical and Metallurgical Engineering*, April 9, 1923. The chief properties for which zinc dust is used may be summarized as follows: (a) reducing properties, as in the dye industry, for reducing nitro compounds to organic amines and in preparing sodium hydrosulfite for the reduction of vat colors; (b) the property of precipitating metals from their solutions, in purifying zinc sulfate solutions for electrolysis or for the manufacture of lithopone; (c) the property of combining with dry oxygen only at a high temperature and of giving with moist air a basic carbonate or with sea air an oxychloride which protects the metal from further oxidation. These properties have led to its application in painting iron objects, sheradizing (that is, immersing iron objects in zinc dust at a temperature of 300 degrees Centigrade), galvanizing cast iron and metallization (that is, deposition by projection of a layer of zinc on the surface of a metal). Zinc dust is usually obtained as a by-product from zinc smelters, but it is also made by blowing gas against a stream of liquid zinc or by grinding. Such dusts contain varying amounts of impurities, some of which are undesirable for certain uses. Microscopic examination has shown that the grains of zinc dust consist of metallic globules coated with crystals of zinc oxide which prevent the globules from uniting.

The Use of Aluminum Vessels

ACCORDING to an article which has been published in the *Zeitschrift fuer das gesamte Kohlensaure Industrie*, volume 51, number 20, aluminum vessels are particularly well suited for the manufacture of light colored lacquers and varnishes. The color of the product is not affected when the manufacture is carried out in these vessels. On the other hand, aluminum is very sensitive to organic acids. When aluminum vessels are used for cooking or distilling in the factory and for cooking food in the household, the interior of the pots and pans and factory apparatus become coated with substances which cannot be removed by the ordinary methods. Hence the following composition was devised and was found to be very effective in removing these deposits from the interior of aluminum utensils. A solution is prepared containing 90 parts by weight of technically pure crystalline sulfate of alumina and 10 parts of soda crystals. The aluminum vessel is filled with water until the dark colored spots and places are covered. About one to three teaspoons of the above saline mixture may be added to the water in accordance with the size of the vessel. After the water has been brought to the boiling point, it is found that the deposit on the aluminum has been entirely removed.

Bio-Chemical Engineering

GIVING credit to C. P. Steinmetz for the idea, a recent issue of *Chemical and Metallurgical Engineering* asks editorially, and answers in the affirmative, the question whether the above words define a new profession of importance. It is pointed out that biology is coming to play more and more a role in our chemical problems. The expansion of the sugar industry through attention to the intensive cultivation of the plant, and the suggestion that the biologist, through the intensive production and the economic utilization of alcohols and other forms of plant energy, may solve the fuel problem, are cited as evidence of the place that bio-chemistry may come to fill in the general engineering structure.

The Heavens in August, 1923

Measuring the Minute Heat Radiations Received by the Earth from the Stars

By Professor Henry Norris Russell, Ph.D.

THE "cold moonlight" is a commonplace of literature, and with good reason. Though the rays of the sun warm us—and cheer or exhaust us according to the season—those of the moon produce not the least effect upon our temperature sense. This is not, of course, because no heat radiation accompanies moonlight, but for the simple reason that the nerves of our eyes are exquisitely sensitive to light while those of our skin are but crudely so to heat. No artificial appliance can begin to compete with the eye in sensitiveness to light—unless indeed we use something, like the photographic plate, which adds up the cumulative action of hours. But it is very easy to make heat-detecting instruments incomparably more sensitive than our cutaneous nerves. With such devices the heat, not merely of the moon but of the stars, can be detected and measured as Coblentz has done at the Lick and Lowell Observatories, and as Pettit and Nicholson have done, more recently and in like manner, at Mount Wilson.

The heat-measuring device is very simple, both in appearance and in theory. Two tiny wires of different metals meet in a little disk, blackened to absorb any radiation which falls on it. If this junction is heated while the rest of the circuit of which it forms a part is unaffected, an electric current will be set up, which can be registered by a sensitive galvanometer. Various metals differ in "thermo-electric power," and by a suitable choice, such as making one wire of bismuth and the other of a bismuth-tin alloy, the current can be increased. If the wire of alloy is soldered to a bismuth wire at each end, and first one junction and then the other is exposed to the source of heat, the currents will flow in opposite directions and the observed effects will be doubled.

Theoretically then things are very simple; but to realize high sensitivity in practice is anything but easy. Since the heat of a star, even though concentrated by the greatest telescope, is very feeble, the receiving disk and wires must be made as small and light as possible. In the apparatus used by Pettit and Nicholson, the disk is about 1/50 of an inch in diameter, and 1/3000 of an inch thick, while the wires, or rather strips of metal, which lead to it are 1/250 of an inch wide and 1/3000 of an inch thick. To assemble and mount so tiny and fragile an affair demands great manipulative skill.

The slightest breath of air blowing past the junctions would cool them more than a star could heat them. So the whole apparatus is put in a glass tube, exhausted to a very high vacuum. The window on this tube, through which the starlight enters, must not be made of glass, but of fluorite or rock salt, which, unlike the ordinary type of glass, are transparent to the long invisible rays as well as to the short ones that we call light.

How the Observations Are Made

All this care would be of no avail were not the electrical instruments equally sensitive. Here, fortunately, the astronomer has the advantage that sensitive galvanometers are used in many lines of scientific work, and can be obtained commercially. The deflections of the tiny suspended magnet are read, as usual, by reflecting light from a mirror that turns with it. If the mirror is of very good optical figure, the scale can be placed as much as twenty feet away and good results still obtained. Such an instrument will give a deflection of two millimeters—very easily observable—for a current of a millionth part of a milli-ampere. This galvanometer is not set up in the dome, but far below in the basement, in a room protected from changes of temperature. The wires connecting it with the receiver at the telescope, which must be about a hundred feet long, must themselves be very carefully installed and shielded.

When all precautions have been taken, and the apparatus is in good order—as the writer saw it a few days ago—it works like a charm. The hundred-inch telescope is set on the star, and the observer, looking through another window at the back of the vacuum cell, sets it first upon one and then upon the other of the junctions. Meanwhile, a second observer, in the basement, connected with the first by telephone, records the readings of the galvanometer.

In practice, this is done photographically, on a plate moved slowly downward while the spot of light swings back and forth across it. It is extraordinary to watch it shift, regularly back and forward, as the star is set on one or other of the two junctions, and to realize that the energy which moves the image actually comes from the star. For in this case there is no terrestrial source of electromotive force set into action by a relay; the star's own heat supplies the power. Calculation shows that less than one fifty-thousandth part of the heat received from the star is turned into electrical energy, and this low efficiency is almost unavoidable; for the rise in temperature of the "heated" junction is little over a tenth of a degree, even for the brightest stars, and for the average star is much less, even, than this.

The heat-measuring device, in its present perfection, adds a new and very important weapon to the armory of the astrophysicist, and we may expect to hear much of its results in the near future. To speak of but one thing now, it is found that stars of different spectral types, that is, of different temperatures, give very different amounts of heat in proportion to their light. For the same brightness, as observed by the eye, the hottest stars send us the least total heat and the coolest ones the most. This sounds very extraordinary until we turn the thing around and say that, for equal amounts of total heat, the hottest stars give us the most light—when we recognize at once the factor of luminous efficiency, familiar to everyone who understands why a tungsten lamp, which runs at a higher temperature than its carbon predecessor, saves half our lighting bills.

What It All Means to the Astronomer

This bids fair to give us the best means at our disposal of estimating the temperatures of the cooler stars. For example, Alpha Hercules, a red star of what is called Class M, gives only about one-fifth as much light, in proportion to its heat, as most stars of its sort, and hardly one-fiftieth as much as a white star like Vega. This indicates that its surface temperature must be much lower—perhaps 2400 degrees, as against 3000 degrees for an ordinary red star like Antares.

This was shown several years ago by Coblentz. The Mount Wilson observers have recently found much more remarkable cases among the long-period variables. Stars of this sort, near maximum, are comparable with ordinary red stars. But near minimum, when their light may drop to less than one per cent of the maximum brightness, their heat is still perhaps one-fifth of the maximum amount. Stars of this sort, invisible to the naked eye, may send us more heat than Vega. In certain instances the ratio of light and heat is something like one ten-thousandth part of the value for a white star. This indicates relatively very low temperatures, probably from 1200 to 1500 degrees Centigrade. We may look upon these variable stars, then, as bodies which periodically and for reasons still unknown, cool down from the ordinary stellar temperatures—which begin where laboratory temperatures leave off—to temperatures such as are found in every foundry. At these lower temperatures practically all the radiation is in the long, invisible waves; the visible light forms but a beggarly fraction of the whole.

Further work with this new and powerful instrument of research will tell us much regarding the temperature conditions of the stars, and of the moon and planets too.

At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.
At 9½ o'clock: Aug. 29.
At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens

Turning to our usual star-gazing, we find Cygnus right overhead—the swan being fairly easy to imagine, flying northeastward down the Milky Way, with his outstretched wings extending into the darker sky on each side. Along the galaxy to the northeast we find Cepheus, Cassiopeia and Perseus; to the southwest, Aquila, Ophiuchus, Sagittarius and Scorpio (setting). Lyra is west of the zenith, with Hercules, Corona and Bootes below. Draco and Ursa Minor are above Ursa Major, all being in the north-northwest. Pegasus is well up in the east, with Andromeda on the left, while Aquarius and Capricornus are in the dull southeastern sky above Fomalhaut.

The Planets

Mercury is an evening star this month, but is south of the sun and is easily seen in our latitude. Even at the end of August, when he is furthest from the sun, he sets at 7:30 P. M. and is deep in the twilight. Venus is a morning star but very close to the sun, and practically invisible. Mars too is behind the sun, and in conjunction with him on the 8th, and is invisible. Jupiter is in quadrature east of the sun on the 3rd, and after that is an evening star, but is visible until after 9 P. M., even at the month's end. Saturn, being about 20 degrees further west, is an evening star too, setting rather more than an hour before Jupiter. Uranus is approaching opposition, and is observable late in the evening. Neptune is in conjunction with the sun, and is invisible. The moon is in her last quarter at 2 P. M. on the 4th, new at 6 A. M. on the 12th, in her first quarter at 1 A. M. on the 19th, and full at 5 A. M. on the 26th. She is nearest us on the 16th, and furthest away on the 3rd and again on the 31st. During the month she is in conjunction with Venus on the 11th, Mars and Neptune on the 12th, Mercury on the 13th, Saturn on the 16th, Jupiter on the 17th, and Uranus on the 27th. On the morning of the 26th a partial lunar eclipse occurs. For an observer on the moon, the first invasion of the sun by the earth's disk would come at 3:12 A. M., by our eastern standard time. But little will be noticed by the average terrestrial observer until 4:52 A. M., when the moon enters the shadow proper. She dips into it slightly, only one-sixth of the diameter being immersed at the maximum phase, at 5:40 A. M.; and she gets clear again at 6:27. This eclipse is without specially noteworthy features.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Stocking Crushed Stone

THE accompanying photographs show the method used in building high stock-piles of crushed stone for highway purposes on Illinois day-labor construction of pavement, under the supervision of the superintendent of construction, H. B. Jay. Three-ton-capacity dumping-body trucks were employed to haul the aggregate from the railroad, and by use of portable runways or tracks up which the trucks ran and dumped their loads, piles were easily built to a height of fifteen feet. The runway sections were designed to be of such a weight that two men could handle units in placing them in position and taking them up and moving to other set-ups.

They were constructed in ten-foot units of 4 x 4 stringers to which were nailed two-inch planks, making the tracks slightly wider than the tires. On top of the plank 4 x 4 guide rails, or curbs, were bolted, so that the trucks would stay on the runways. Each ten-foot unit was attached to the next one by means of three-quarter-inch iron hooks and eyes, and fastened together laterally by the same method. All units were interchangeable.

Pile of crushed stone, as built by dumping motor truck

The Lubrication Problem

MORE and more attention is being given to correct lubrication of motor vehicles, for it is realized that no class of machinery requires more thorough lubrication. Various systems for supplying oil and solidified oil to various parts of the motor truck have been introduced of late. The most popular is in the form of a modified grease gun which is provided with a flexible hose and coupling for attachment to the special fittings where grease or solidified oil is to be delivered. A moment's work suffices to lubricate each part of the truck.

Showing how tracks are laid up the stone pile to provide a runway for the road construction truck

New Cushion Tire for Trucks

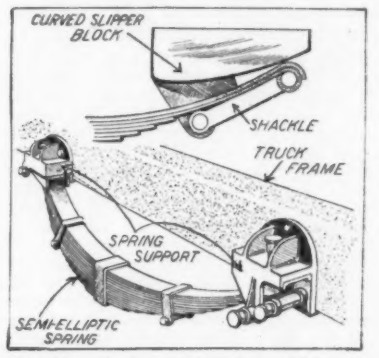
A PROMINENT tire company has announced the details of construction of its new "aircore" cushion tire for trucks. Produced in the full- and double-cushioned types, the new tire is designed to provide displacement spaces located on both external and internal points to accommodate the flow of rubber when under pressure. The company, pointing out that the solid tire tends to bulge out at points in front of and at the rear of the area in contact with the road, asserts that the external spaces, in the form of specially designed notches cut in the side walls and tread and the central hollow ring or core surrounding the base band of the tire, will take care of this "flowing" tendency. The notches not only furnish displacement space but also a sure-footed traction in all weathers. In order to prevent the accumulation of stones or caked mud in the notches or vents, pebble ejectors, in the form of a step-like formation of rubber lugs, are provided in each notch.

The principal cushioning ability of the "aircore" tire, however, which permits deflection under load equal to that of normally inflated pneumatic tire, lies in the use of the central hollow ring which is in the shape of a continuous ring of a spear-shaped cross-sectional opening. The advantage claimed for this type of cushioning is that the rubber displaced merely follows the easy curves of the core and side walls and allows the instantaneous recovery of the rubber to its normal shape after encountering obstructions in the road. This latter feature is made possible by the short "nose," or distance between the outer end of this hollow space and the tread of the tire. If the road shock were to be transmitted from the tread to the small circular opening near the base of the tire, a perceptible lag would be created which would render the action of the tire practically the same as that of a solid tire at high truck speed. The "aircore" tire is intended by its makers for front wheel service on all trucks except the heaviest, and for rear wheel service on those trucks which require resiliency, high speed ability and economy of operation. It is made in sizes ranging from 34 x 4 to 40 x 8 and 36 x 10. The prices of the various sizes are considerably less than those of the same capacities of truck pneumatic tires.

Variable Length Springs

IN a recent British truck the semi-elliptic rear springs have front and rear anchorages rendering them stiffer and augmenting the carrying capacity with increasing load, and vice versa. The rear ends of the springs, themselves of almost normal design, are anchored to shackle plates as usual, though the plates project rearwardly at an angle of approximately 30 deg. from the horizontal instead of being almost vertical with "no load," as shown in accompanying illustration. Above each spring end the frame bracket has attached to its underneath surface an inverted curved slipper which, as the spring becomes deflected with increased load, forms an abutment for the end of the top leaf, progressively shortening the effective length of the spring.

The shackle plates merely serve to locate the springs, for the latter come into contact with the slipper almost immediately the first portion of the load is put aboard. The slipper is separate from the actual bracket, being of case-hardened steel and renewable. Grease cups are provided for the contact surfaces of slipper and spring as well as for the shackle pins. At the front ends the slippers also appear, though the shackles are absent. The accompanying sketch shows this scheme, which, while of benefit with quarter and half loads of merchandise, especially fragile goods, shows to greatest advantage in connection with passenger transport vehicles which are apt to be lightly loaded at some times and heavily loaded at others.



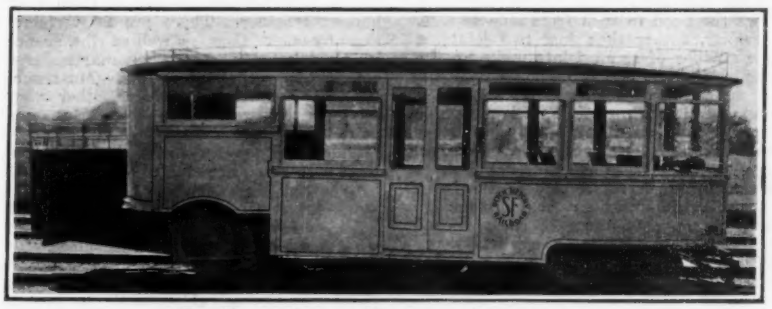
Details of the design by which the springs are automatically lengthened as the load increases

A New Type of Rail Car

THE accompanying photograph shows a gasoline driven rail car recently delivered to the Hetch-Hetchy Railroad at Groveland, California. This car has many new and distinct features. It seats thirty passengers and is built for either narrow or broad gauge railroads. On the Hetch-Hetchy Railroad it negotiates a five per cent grade, twelve miles long, with numerous 30 degree curves, at a speed of 27 miles per hour. The Hetch-Hetchy Railroad have been operating gasoline motor cars for the past six years and this car is said to be more efficient than any of their previous equipment.

By placing the motor rearwardly of the driving wheels all revolving parts in front of rear axle are eliminated, thereby permitting a very low hung car, and all motor noises and smoke or gasoline odors are at the rear. The passenger seating capacity has been increased without lengthening the wheel base and better traction secured by suspending the motor on coil springs direct over rear axle on one end of a sub-frame attached to the main frame.

The sub-frame makes one-half of a complete truck as it has a swivel bolster built in the main frame so that it will turn at curves, thus eliminating flange wear and relieving side thrust. It is said that the car rides as well in the rear seats as in the center. The car complete weighs but 10,400 pounds and makes eight miles per gallon of gasoline. The same principles may be used in construction of stages and omnibuses to run on the highways.



Gasoline rail car with power plant at rear

A Large Tractor Trailer Outfit

WHAT is regarded as the largest pressed-steel drop-frame semi-trailer that has ever been built is 48 feet long over all, 8 feet wide and 12½ feet high from the ground to the top, and is built to conform with the State of Michigan's trailer law, the maximum limit of which is 60 feet. This trailer was designed to haul automobile chassis to South Bend, Indiana, and to bring back from South Bend automobile bodies. On each trip out of Detroit it carries five large chassis and on the return trip brings back 24 open automobile bodies painted and upholstered. The largest freight-car can handle only from 16 to 18 bodies. The excessive freight rate on this class of commodity enables this trailer to handle 24 bodies for approximately one-half of what it would cost to transport them by rail. The bodies in this trailer stand up end-wise and are held in position by steel and wood frames so that they hang clear of the floor and do not rub or touch each other. They are brought into the city of Detroit free from dust and scratches.

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Possibilities of Subluxations

To the Editor of the SCIENTIFIC AMERICAN:

Some time ago you had a vigorous editorial against the promiscuous licensing of chiropractors. I have no more patience with this cult than you have, but unless we confine ourselves scrupulously to the truth when we attack them, we strengthen them rather than weaken them. Misstatements of the sort you made in the preliminary portions of this editorial are very common, and frequently are such as to throw discredit upon osteopathy.

You infer that blindness and deafness cannot be cured by correcting subluxations, because "the nerves to eye and ear never leave the skull." The optic and auditory nerves to be sure are cranial, but some of the nerves affecting the eye and the ear come from the spine. From a very complete discussion by Dr. Lloyd Mills, F. R., C. S., in the *California State Journal of Medicine* for January, 1921, I abstract the following items:

The eye becomes softer after section of the cervical sympathetic. Cervical tumors and fractures affect the eye. Excision of the superior cervical ganglion in glaucoma has been followed by improvement in 40 per cent or more of cases. Numerous cases of pupillary irregularity may be cited in connection with enlarged cervical glands, mediastinal growths, aortic aneurism, pulmonary phthisis, pneumonia, thyroid tumors, etc., etc.

I have met a man, blind for two years, whose sight was restored in a matter of hours by correction of cervical subluxation, by an osteopath. I am personally acquainted with four osteopaths who have fully restored or greatly improved the sight of persons entirely blind, by cervical adjustment.

I should like to consider with you some possibilities in connection with the topmost segment of the spinal column, called the atlas, on which the head rests. A study of the atlas and its relations will show how easily they can become disturbed and some of the troubles that may come from such a disturbance.

The joint above the atlas, between it and the skull, allows the rocking motion of nodding the head; that below the atlas allows the head to turn from side to side. In reality, rather than just two joints, a large number of small joints make up the articulations of these three bones.

A sudden turn of the head, a blow, a bump, a fall, can produce sufficient trouble in one of these small joints to prevent free movement. Also there are many muscles, large and small, attached to the skull from neck and shoulders. A cold draft of air, a slight strain or injury, or other trouble may cause one of these to contract and hold one of the joints in a slightly unnatural position. It is not so much that a bone goes beyond its normal range of movement, as that it becomes to some extent immobilized within that range. Hence the failure of the X-ray to locate some of the things for which the osteopath treats. Among the results may be headache, heart or stomach trouble, deafness, blindness, convulsions, insanity, imbecility.

There are among the imitators of osteopathy those who pretend to be able to touch the spine, find which bone is misplaced, and tell exactly where the resulting disease may be found. This is impossible. These people also publish pictures of the spinal column, showing how a slip of one vertebra upon another may cause pressure upon a nerve, resulting in disease. This looks and sounds very convincing, but dissections of the human body do not bear out the theory that a vertebra can ordinarily press upon one of the nerves, and the picture of a nerve's being so pinched is an anatomical absurdity.

Much of the blood supply of the brain comes through arteries that pass up with the vertebræ. They are protected by the spinal column in the neck, actually passing up through little holes in the sides of the vertebræ. When the atlas slips in relation to the skull, these arteries are interfered with and the medulla and brain stem do not get as much blood as they need. The eyes may suffer in consequence, or any of the other organs or functions mentioned above. The same lesion could cause a general nervous condition, because most of the nerves connecting the brain with the body must pass through this same brain-stem region. Messages come in on nerves from all over the body, telling the brain what the conditions are, and the brain sends back messages telling the muscles what to do in consequence.

The incoming sensations could be interfered with in this region, so that the brain may get wrong messages and send back wrong orders to the muscles. To make matters worse, the nerves which carry the orders out to the muscles can also be interfered with here, and all sorts of jerkings and movements and even convulsions could result. All of this is in conformity with the theory of Dr. A. T. Still, founder of osteopathy, who announced in 1874 that "The rule of the artery is absolute."

The internal carotid arteries bring the rest of the blood to the brain. The caliber of the internal carotids is affected by fibers coming through the superior cervical ganglion of the sympathetic system, a bundle of nerves so close to the atlas that its blood supply, in turn, can be influenced by an atlas lesion.

Neuralgia of the face may also be caused by such a lesion. The chief nerve of sensation in the face arises from the brain and not from the spinal cord. Yet some of its fibers pass up to the brain from the upper part of the cord. It is easily seen how the blood supply to these fibers can be affected.

The vagus nerve is so called because it is such a vagrant or wanderer. It passes down from the brain as far as to the heart and the stomach. It emerges from the skull so close to the atlas that it can be affected, and far-reaching systemic disturbances brought about by the atlas lesion. These are only a few examples of the damage that may be done by a subluxation of one of the vertebræ. Any one of these things may happen. Many of them may happen together. There are 24 vertebræ and any one of them, as well as ribs, scapulæ, clavicles, and other bones, may suffer a subluxation with bad results. Most subluxations reduce themselves, either very soon, or when we relax in sleep. But some do not.

These osseous lesions, their effect and their correction, are studied and understood by osteopathic physicians. I cannot say as much for any other school of healing. I have outlined but the barest sketch of what actually does or may take place. To cover the subject would require a book.

The only reason I have for offering these remarks on chiropractic to you is that you are among those who have overstepped the subject and unintentionally cast doubt upon facts discovered and proved by Dr. A. T. Still and his followers, who constitute a reputable and recognized profession.

RAY G. HULBURT, D.O.

Kirksville, Mo.

Gyroscopic Motion

To the Editor of the SCIENTIFIC AMERICAN:

The "classical" theory of gyroscopic motion propounded by the mathematicians and generally assumed to be correct involves the proposition that if all friction and air resistance were removed, the spinning wheel would describe indefinitely about the central support a series of festoons, the cusps of which would lie in a horizontal plane. This theory is clearly expounded in Barnard's "The Gyroscope" (1858). He says that if the described cycloid were a "material curve on which the axis of the gyroscope rested without friction and without rotation it would travel along this curve by the effect of gravity alone (the velocity of descent on the downward branch carrying it up the ascending one) with exactly the same velocity that the rotating disk does through the combined effects of gravity and rotation." This proposition is obviously untenable. The wheel in such case would not rise to the height from which it descended. No force would be applied by the stationary "material curve." The curve would, of course, deflect the motion of the descending wheel but in deflecting it it would check it (regardless of friction). The wheel would move the "material curve" in the opposite direction thereby imparting to it some of its energy. Hence the wheel would not rise to the height from which it fell. And if it did, why when it reached the top of a cusp would it go forward instead of backward?

Barnard then says that "rotary motion" of the wheel has "precisely" the same "effect" as the "material curve"—that it deflects "the body's path from vertical descent, finally directs it upward, and causes its velocity to be destroyed by the same force which generated it."

But "rotary motion" is a force and if such force causes an "effect" it is thereby to the extent of the "effect" generated, transformed; and if it be transformed to some extent, to such extent will its quantity in its original form be diminished. "Rotary motion" cannot produce an "effect" without becoming impaired. Hence the wheel will (in the absence of friction) finally cease to rotate. Its force will be spent in the effects generated—precession and support of the wheel and axle against the opposed pull of gravity.

Barnard also says that "rotary motion has no power to impair the work of gravity through a given height in generating velocity; but it does have the power to change the direction of that velocity." But certainly if it has the "power" to do this, and exerts such "power," to the extent that it does so by so much is its "power" reduced.

Because "rotary motion" has the "power" to "change the direction of" a "velocity" he infers that it can do so without impairment of its "power." But, of course, "rotary motion" can no more "change the direction" of a "velocity" without loss of its "power" than it can generate a "velocity" without such loss. It cannot have its cake after it has eaten it. According to the "classical" theory precession is an effect without a cause, *i. e.*, without a transformation of that which produces it.

The theory is plainly erroneous. Precession is occasioned by the force of gravity and caused by the force stored in the spinning wheel. Gravity tilts the wheel, thereby partitioning the force stored in it, part of which is then applied so as to generate rotation around a new axis. The application of such force to the wheel induces precession. It cannot revolve the fixed support around the wheel and so the wheel revolves around the support. Precession in turn results in the application of part of the spin-force against gravity and if it be sufficiently strong it will prevent the wheel from falling at once. Stopping precession shuts off the application of spin-force against gravity and the wheel drops. The removal of friction resulting in increased precession and the application of more spin-force against gravity prolongs the contest between the two forces but at length the spin force becomes too feeble to sustain the weight of the wheel and axle even under the stimulation of external force applied to increase precession. The "classical" theory is based on the assumption that the down-pull of gravity is "balanced" by an equal up-pull. But the force of gravity is practically inexhaustible, whereas the up-pull arising from the small amount of force stored in the wheel, is soon exhausted. Just as in time the force opposed to gravity when a weight is held in the hand will become exhausted and the weight will fall.

The force stored in the spinning wheel but originally stored in the muscles of the arm of him who spun it will in time be overcome by the greater force of gravity. A constant "balance" of the opposed forces is a mechanical impossibility. The gyroscope is not, as it has been called, a "mathematical device." It is a real thing and its movements conform to mechanical laws.

The proponents of the "classical" theory say that the humming of the wheel when the rotation is rapid is due to minute cycloids formed as described by Barnard, whereas in fact it is due to vibrations caused by friction. According to their theory the cycloids occur only when there is no friction. Friction would obliterate them. It is remarkable that this barbarous theory has persisted unexposed into this enlightened age.

L. A. REDMAN.

New York.

Mathematics and the Spirits

To the Editor of the SCIENTIFIC AMERICAN:

I am deeply interested in your articles "Our Psychic Investigation in Europe," by J. Malcolm Bird, Associate Editor. I have also read the statements made by Father C. M. de Heredia in various publications.

Let us now look and examine the question of spirit photography from another angle. Let us assume that the average death rate in a civilized community is 10 per thousand (which is low), and the average death rate in an uncivilized community is from 20 to 25 per thousand. We will take an average of 15 per thousand. The population of the world is stated to be sixteen hundred millions, making the total deaths per annum twenty-four millions, or twenty-four million spirits per annum. Now the age of man is variously estimated from six thousand years to sixty million years; the first estimate is not accepted by science. What is the age of the Neanderthal man? The Piltdown man? The Javan man? The answers are largely theoretical. Let us take the age of man from his first appearance and estimate the time one million years (also a low figure), multiply the above twenty-four millions by one million, we have a total of twenty-four quadrillion spirits! (a figure too stupendous for our imagination) since the birth of man, assuming that spirits are immortal.

Now questions arise: What is the position of spirits in space? Are they in our immediate vicinity? They must be or they could not be photographed. Do they occupy vacant space, or all space? When we move, do we push them aside? Do excrescences such as built by man, buildings, etc., displace them? Do fast-moving vehicles run over them (horrible thought), or push them aside? Do spirits have length, breadth and thickness, or just length and breadth, exhibiting only the face? Is the entire body spiritized?

Does each spirit have a separate space or are they a confused jumble? Now let us add the query, does man alone have a spirit? Or, has every living thing a spirit? If so, the total number of spirits since life began makes the question of spirit photography (to me) ridiculous; as there would not be room on the face of the earth or in our atmosphere for such a vast number of spirits.

Will some believer in spirit photography answer these questions. Many other questions arise in my mind, but these are sufficient.

It is perhaps needless to say that I am skeptical, but am ready to be convinced, and trust that your investigation will result in a definite conclusion.

A. S. LOWELL.

Worcester, Mass.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRPLANE.—D. R. MCCULLOUGH, R. D. 58, Fellows, Calif. The particular object is to provide an airplane that has a maximum amount of lifting power as compared with the space occupied by the same. A further object is to provide planes that present a smooth forward edge, while the rear edge is toothed whereby an effect is obtained somewhat similar to that of the wings of a bird in flight, means being provided whereby the planes may be decreased in size. A further object is to provide means for creating an artificial partial vacuum whereby a lifting power will be exerted and ascent facilitated.

Pertaining to Apparel

FASTENER FOR REVERSIBLE GARMENTS.—J. J. SOMERS, 48 Washington Terrace, Bridgeport, Conn. The general object of this invention is to provide a fastening for use with corsets and similar garments for converting them into reversible garments and thus to prolong the life of the garment. The fastener comprises loop and stud members, with means for forcing the studs to either side of the reversible garment to engage the loops.

Electrical Devices

FLASHLIGHT.—H. M. KORETZKY, c/o Bright Star Battery Co., 310 Hudson St., New York, N. Y. The invention aims to provide a flashlight, the primary object of which is a construction by means of which an operator may manipulate the parts to absolutely preclude any danger of a circuit becoming accidentally closed, resulting in the exhausting of the battery, so that the operator may pack the flashlight among tools or metallic objects without fear. A further object is the provision of means which virtually preclude any danger of the stem of the bulb becoming injured.

MARKING DEVICE.—MARIE L. GARCIN, 238 W. 35th St., New York, N. Y. An object of the invention is to provide a device more particularly intended for use in connection with photography, and by means of which sub-titles and identification marks may be associated with a plate or film by directing a minute stream of electric light against the sensitive surface of the plate thus exposing that portion of the same directly underlying the device, so that when the plate is developed and the positive printed the title will be present.

VOLTAGE-CONTROLLING DEVICE FOR DYNAMOS.—G. C. HUBBLE, Box 408, Bonners Ferry, Idaho. The invention relates to a device for controlling the field winding of dynamos. An object resides in the provision of means whereby the field excitation of dynamos can be sensitively controlled by automatic means which is actuated in accordance with load variations of the dynamo. A further object is to provide a controlling means applicable to dynamos with a minimum necessity for alteration in their construction.

SIGNALING MECHANISM.—J. C. SIMS, 26 Walnut St., Maynard, Mass. The invention relates to an electrically operated visual and sounding signal, an object being to provide a signal which may be seen and heard by night or by daylight, and which will be automatically operated. A further object is to provide a signaling mechanism which is adapted for use as a railroad signal, a burglar alarm or for any other use to which such a device might be applied.

Of Interest to Farmers

SILO.—J. MATTSON, 153 W. Chestnut St., Chicago, Ill. An object of the invention is to provide a silo having a flexible closure supported for movement vertically, said closure being adapted to comfortably fit within the silo casing at all times. A further object is to provide means for balancing the weight of the closure to insure ease of operation. The device is simple and can be produced with the materials ordinarily available.

TRANSPLANTING DEVICE.—H. D. ELLIOTT, Tabor, N. C. The invention relates more particularly to a device adapted for planting potatoes, sprouts, vines, and the like. An object is to provide a simple device in the nature of a handled implement like a shovel or spading fork, which will serve to form the desired cavity in the ground to receive the plant, and to supply the necessary water or fertilizing mixture to assist the plant in taking root.

PORTABLE COMBINED COTTON PICKING, GINNING, CONDENSING AND COMPRESSING MACHINE.—MARY W. SILVERTHORNE, 34 W. 53d St., New York, N. Y. The most important feature of this invention resides in the combining of cotton picking, ginning, condensing and compressing mechanism on a vehicle to render the machine portable and capable of being moved into a field as an entire unit so that the complete operations from the picking of the cotton to the baling thereof may be finished on the field, with a minimum number of helpers, the cotton being transferred from one process to another by a continuous air current. (See Fig. 1.)

BACKBAND HOOK.—E. W. BAILEY, Lawley, Ala. The invention relates to hooks for the backband of draft animals, the principal object being to provide a hook which will serve to firmly support the trace chain and prevent the same from slipping in either direction. A further object is to provide a hook so constructed that a trace chain may be readily attached thereto, and a hook which will be simple and practical in construction, strong and durable in use, and inexpensive to manufacture. (See Fig. 2.)

SPRAYING DEVICE.—A. A. STUBFORS, Spooner, Wis. The invention relates to a device for spraying a liquid upon plants in the field. An object is to provide a flexible attachment for a movable spraying machine which will co-act with the latter to bend standing plants at the time the liquid is discharged so that the plants, including insects clinging to the under side, will be drenched with the spray solution. The device may be adjusted for use on plants of various heights.

Of General Interest

ATTACHING MEANS FOR SEPARABLE FASTENER ELEMENTS.—B. Z. HAUSNER, c/o Empire Notion Co., 72 Madison Ave., New York, N. Y. The invention relates to means for attaching separable fastener elements to a support, particularly to means for attaching snap fasteners to paper envelopes, folders or cardboard box closures, and resides broadly in the use of adhesives for this purpose. The primary object is to provide attaching means which firmly hold the fasteners and which will be simple and practical in use. (See Fig. 3.)

VANITY CASE.—W. G. KENDALL, 118 Market St., Newark, N. J. Among the objects of the invention is to provide a vanity case, the body of which is divided into two compartments, and having a removable bottom plate, together with the provision of means whereby this plate automatically locks itself within the case upon its insertion. One of the principal objects is the construction of a case in which the compacts carried may be renewed from time to time without defacing the case.

MAIL RECEPTACLE.—N. PANAGOPOLOUS, c/o Brainerd & Cotwals, 411 Surety Bldg., Muskogee, Okla. The invention relates more particularly to receptacles for mail deposit and collection boxes, the object being the provision of a receptacle including a pouch bodily shiftable into and out of the mail box with means to receive therein deposited mail so that the collector need not handle individual pieces of mail but may withdraw the deposited mail in a single operation.

LAST FOR SHOES AND SANDALS.—J. THOMAS, 210½ Heron St., Aberdeen, Wash. The general object of the invention is to provide a last adapted to be placed against the shoe at the exterior instead of being inserted in the shoe. A further object is to provide a last that will enable the sole to be fastened neatly, and practically invisibly, by nailing with the edge of the sole placed against the last disposed at the exterior of the sandal.

AWNING CONSTRUCTION.—W. F. O'DONNELL and C. SEYBOLD, c/o W. F. O'Donnell, 524 W. 78th St., Chicago, Ill. Among the objects of this invention is to provide an awning construction having means for controlling the operation of the awning from the interior of the structure, such as a dwelling, to which the device is applied, and means for partially housing the awning fabric to protect the same from rain, snow, and the like. The device may be applied to a window frame of ordinary construction without extensive alterations of the latter.

IRONING BOARD.—R. A. MORRISON and F. L. OSWALD, 1007 Board of Trade Bldg., Portland, Oregon. The invention relates to folding ironing boards. The object is to provide a board with three legs which folds and unfolds easily; which requires no fastening means such as hooks or similar attachments; which when extended will have the necessary rigidity to facilitate the ironing operation without requiring unnecessary effort; which permits the ironer to stand directly over the work, and on which the entire surface is solid under pressure.

FLY HOOK AND LEADER.—P. F. HALFERTY, 314 E. Pike St., Seattle, Wash. The general object of the invention is to provide a quick detachable fish hook and to provide a leader with snells so connected that the use of the undesirable loops now employed is obviated, as well as to provide a knot on the lower end of the leader particularly adapted to coact with the hook. While adapted for use with plain hooks to receive a bait, the device is particularly useful for a fly hook and leader.

GREASE GUN.—J. M. MILLS, c/o State Nursery Co., Helena, Montana. An object of this invention is to provide a device having a hinged, spring-held nozzle which can be moved to one side and permit the gun to be loaded at the nozzle end. A further object is to provide a special form of plunger, and a construction of gun which will be strong and practical in use.

ADJUSTABLE FORM TIE AND SPACER.—J. C. BUCHENAU, 202 Lillian Ave., Eastwood Sta., Syracuse, N. Y. The invention relates to a wall mold or form and the general object is the provision of a device adapted to constitute an adjustable tie and spacer between the sides of the form. A more specific object is to provide for adjustably connecting the sections without the employment of bolts, screws or other fastening means.

CLAMP FOR ROOFS.—C. C. WHITE, c/o R. C. Cowon, Gulfport, Miss. The general object of the invention is to provide clamps for use on roofs in various portions at the joints, at the overlapped shingles, at the peak, and as an edging for the roof, whereby to make the roof water-tight and keep it from buckling or warping, as well as to prevent nails when over-driven from damaging the roof, and in addition, the roof is given a better appearance.

CONCRETE STRUCTURE.—J. A. WHITE, 2320 6th Ave., Seattle, Wash. The invention relates to concrete structure adapted to be employed in the construction of dwellings. The object is to provide structures so arranged and related that when assembled they present great strength and rigidity, the walls being substantially hollow. Another object is to provide a structure with means whereby the interior finishing of floors, ceilings or side walls may be easily and securely fastened to the wall proper.

BUILDING CONSTRUCTION.—R. H. IRWIN, R. F. D. No. 4, Box 32, Medford, Conn. The invention aims to provide a building especially adapted for use as a garage, or for storage purposes. The object is to construct a building in such a manner that space heretofore wasted will be used to the fullest extent and that vehicles stored therein will be readily available and that backing will be practically eliminated, the vehicles after entering the building being placed upon a turntable and brought in direct contact with the compartment to be occupied. (See Fig. 4.)

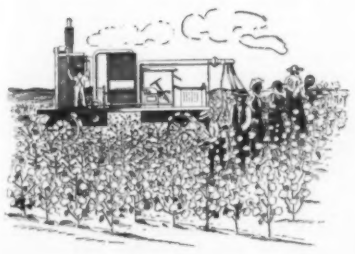


Fig. 1: Continuous operation in the cotton field, from picking to baling, as devised by Mary W. Silverthorne

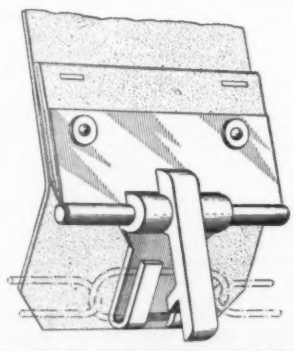


Fig. 2: E. W. Bailey's improved backband hook leads to more effective harnessing of draft animals

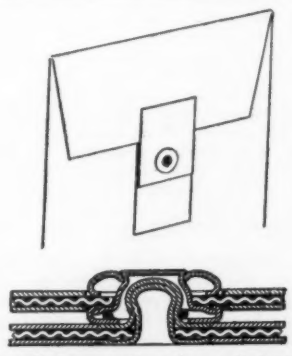


Fig. 3: Better operation of snap fasteners is the aim of B. Z. Hausner's invention, pictured here

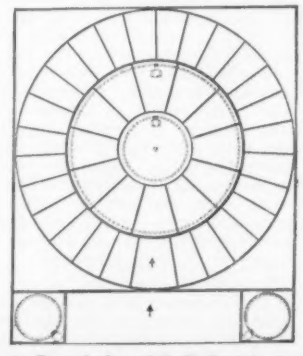


Fig. 4: Ground plan of R. H. Irwin's circular turntable-equipped garage that eliminates backing around

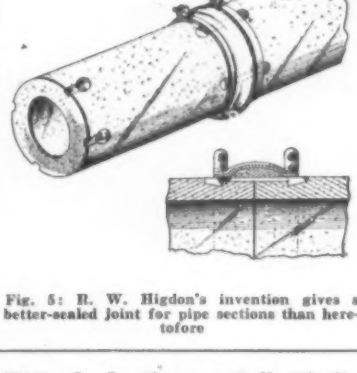


Fig. 5: R. W. Higdon's invention gives a better-sealed joint for pipe sections than heretofore

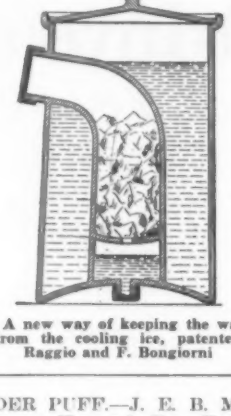


Fig. 6: A new way of keeping the water separate from the cooling ice, patented by J. Raggio and F. Bongiorni

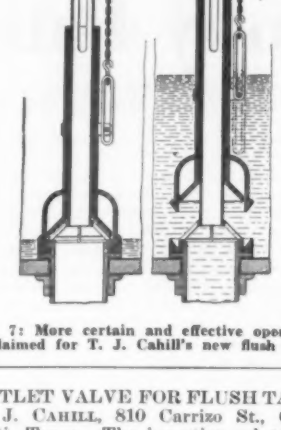


Fig. 7: More certain and effective operation is claimed for T. J. Cahill's new flush valve

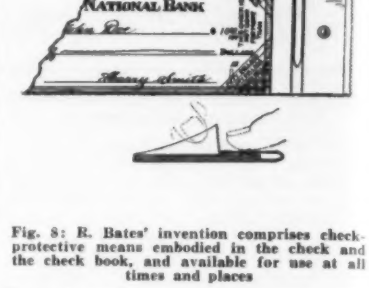


Fig. 8: R. Bates' invention comprises check-protective means embodied in the check and the check book, and available for use at all times and places

TAG.—L. L. MOORE and F. W. RADCLIFFE, 986 So. New Hampshire St., Los Angeles, Calif. An object of the invention is to provide a tag for highly polished and delicate articles, such as silverware and jewelry likely to be scratched by ordinary price tags. A further object is to provide a cloth covering constituting a means for protecting the tag from engagement with the articles to which it is attached.

CONVERTIBLE FURNITURE. — LORA E. HOLMES, 277 Hillyer Ave., Macon, Ga. The invention particularly relates to a kitchen cabinet. The object is to provide a cabinet of artistic appearance and durable service, which will save much room and will serve for the storage of unprepared food and cooking utensils, and which may be quickly converted into a table when desired.

PIPE JOINT. — R. W. HIGDON, 741 Peachtree St., Atlanta, Ga. The object of this invention is to provide means for connecting the meeting ends of a pair of terra cotta, or similar pipe sections in such a manner that the sections are securely held in alinement. A further object is to provide a pipe joint which utilizes cement in a more or less semi-fluid state to connect the sections and firmly hold the joining keys within the sockets or grooves provided for that purpose. (See Fig. 5.)

CUE-TIP FASTENER.—H. J. GRENIER, c/o Mrs. Jacobs, 141 Grasmere Ave., Fairfield, Conn. The invention pertains broadly to billiard cues and more particularly to the provision of fastening means for a cue attachment of the kind comprising a tip and a backing element on which the tip is to be secured. Among the objects is to provide flexible wire members embedded in the tip and passed through holes in the backing element which when screwed down on the arc will serve to finally clamp the tip.

CALENDAR.—W. H. BAKER, 1001 E. 9th St., Newton, Kan. An object of the invention is to provide a calendar which may be used for a period of 12 years or more. A further object is to provide means for bringing the various days and years into registration with an opening, so that the desired month and year may be viewed. The device is simple and not likely to easily get out of order.

SHOE FASTENER.—B. M. KLEIN, 38 E. 85th St., New York, N. Y. The primary object is to provide a shoe-string holder which is simple in construction and operation. Another object is to provide a shoe-string holder which is readily attached to the upper edge of the shoe to receive the loops of the knot of the shoe lace, the holder being adjustable to hold loops of various lengths, and to be easily removed by the user when not desired.

CAMERA.—V. CALABRESE, 1152 49th St., Brooklyn, N. Y. Among the objects of the invention is to provide a film-winding mechanism which may be operated to position an unexposed section of the film strip behind the shutter-opening after each operation of the shutter. A further object is to provide an automatic winding of the film by which the paper strip on the film will be wound upon the spool before the first exposure and after the last, in order that the spool may be removed from the camera without danger to the exposed sections.

COMBINATION FURNITURE.—A. L. NEIL, 542 50th St., Brooklyn, N. Y. An object of this invention is to provide a combined table and ironing board, the ironing board being of the folding type. A further object is to so construct the ironing board that it will be foldable within the table when not in use, and supported by the table when in operative position.

POWDER PUFF.—J. E. B. MAILLARD, Coulombs, par Nogent le Roy, France. The invention has for its object to provide a device so arranged that the powder is enclosed between a support and a permeable surface which prevents it from freely escaping, while it can be pressed between the two surfaces and thereby distributed by degrees until the powder is completely used up.

TIME INDICATOR.—C. W. JAEGER, c/o Bank of Westby, Westby, Wis. The invention relates to direct reading indicating or computing devices. An object is to provide a device for use in banks and like institutions in the calculating of the number of days occurring between two given dates. A further object is to provide a device having means for disclosing results without any manipulation of the device being required beyond an initial adjustment.

SILICATE COMPOSITION.—L. SEIDEMAN, 246 W. 113th St., New York, N. Y. An object of this invention is to provide a silicate composition adapted to serve as a bronzing or other metallic paint liquid or vehicle, as a leather dressing or as a substitute for varnish and shellac, which is incombustible, inodorous, dries quickly with a brilliant gloss, and mixes well with bronze powder, inks, or dyes. The composition comprises sodium silicate having a density of 40 deg. Bé, and corn oil.

BINDING CASE FOR HOLDING SHEET MUSIC AND THE LIKE.—J. W. WEST, 9 Bushey Hill Rd., Peckham Rd., Camberwell, London, S. E., 5, England. The invention relates to binding cases for holding sheet music and other double-leaf papers. The primary object of the invention is to provide a binding case, so constructed as to allow any selected paper contained therein to lie flat, without tendency to curl upwards, when the binding case is laid open so as to expose the particular paper selected.

GRAND STAND CONSTRUCTION.—B. J. LAMBERT, 5 Fairchild St., Iowa City, Iowa. The general object of the invention is to provide a grand stand structure formed of steel plates in step form providing on the treads thereof seats, the structure as a whole reflecting practical considerations with respect to strength and simplicity of construction, arrangement of bracing and the character of the seats.

RECEIPTACLE.—J. RAGGIO and F. BONGIORNI, 617 53rd St., Brooklyn, N. Y. One of the principal objects of the invention resides in the provision of a receptacle for drinking water which includes a separate compartment for ice as a cooling medium, whereby the practice of placing the ice directly in the water is eliminated. The invention further aims to provide means for drawing off the water from the melted ice without emptying the receptacle proper. (See Fig. 6.)

COLLAPSIBLE DRAWING BOARD.—L. L. OBERWARTH, Frankfort, Ky. The invention has for its object to provide a collapsible drawing board which comprises a minimum number of parts, which can be quickly and readily assembled or disassembled, and when disassembled can be packed in a small space for transportation, and the convenience of a traveling man. The device is not intended as a piece of office furniture.

CHECK PERFORATOR. — R. BATES, Box 117, Nevada, Mo. Among the objects of the invention is to provide a simple device that may be employed to quickly perforate a check following the lines of the letters and numerals in the amount for which the check is drawn. The device is portable and will serve to prevent tampering with the check after once drawn.

OUTLET VALVE FOR FLUSH TANKS. —T. J. CAHILL, 810 Carrizo St., Corpus Christi, Texas. The invention relates generally to outlet valves for flush tanks of toilet bowls. The main object is to provide a valve which is constructed in such a manner as to trap a volume of air, whereby upon the initial lifting of the valve the air trapped therein will operate to buoy the valve in the water until the emptying of the tank is effected. (See Fig. 7.)

BANK CHECK AND CHECK BOOK.—R. BATES, Box 117, Nevada, Mo. An object of this invention is to provide a safety check to prevent the check being raised materially beyond the amount for which it is drawn. A further object is to provide a check book having a cutter or severing attachment for detaching a corner or corners of the check designating the monetary value, nearest the amount for which the check is drawn. (See Fig. 8.)

DISPLAY EASEL.—G. A. DONALDSON, Girard, Ill. The invention relates to display easels of thin material such as cardboard, celluloid, sheet metal or the like, an object being to provide means for preventing accidental movement of the back stay when the latter is in operative position. A further object is to provide a back stay which will fold flat, and an attachment which will hold the back stay at right angles to the face.

PLANT RECEPTACLE.—E. C. WEIDIG, 36 Carrollin Ave., New Orleans, La. An object of the invention is to provide a baffled drain outlet in the bottom of a plant receptacle which will permit an excess of water to escape, but which will hold back the earth in the receptacle. The device is intended to be applied to what are commonly termed "concrete or cement pots," boxes or vases.

TOY FURNITURE. — A. DUFFIELD, Derby, Conn. Among the objects of the invention is to provide elements or units of construction which when united will form various articles of furniture. A further object is to provide toy furniture made up of sheet metal parts having an arrangement of coupling which enable the parts to be readily assembled, and which will be strong and durable to withstand rough usage.

VALVE.—W. R. SMITH, Lompoc, Calif. This invention while relating in general to valves has reference more particularly to a construction which is especially applicable to irrigating and the like systems of water distribution. The primary object is to produce a valve which is simple in construction yet capable of carrying out its intended use with efficiency and convenience, both in installing and manner of operation.

CONCRETE-WALL CONSTRUCTION. —A. H. NELSON, 530 N. Center St., Turlock, Calif. The principal object of the invention is to provide a convenient means for constructing a hollow concrete wall. A further object is to provide a form by means of which the wall may be constructed shipwise, and during the construction reinforcing members holding the walls in spaced relation may be introduced without in any manner interfering with the proper operation of the form.

STEREOPTICON DEVICE.—W. H. C. DUDLEY, Americus, Ga. The invention relates generally to picture projecting machines and more particularly to the projection of stereopticon pictures for printed matter for advertising purposes. The purpose is to provide a simple and inexpensive stereopticon device designed for attachment to the lamp housing of a motion picture projecting apparatus, by means of which advertising matter on a transparent strip of film may be projected and displayed.

FILM HOLDER.—C. S. HOWLAND, 124 Campbell St., New Bedford, Mass. The invention particularly relates to film-holding frames adapted to be used in the process of developing X-ray films. An object is to provide a holder which will firmly grip a film, and may be used to hold the film in the developing and washing, and also as a support while the film is drying.

SCAFFOLD.—W. J. MURRAY, 33 Barry Ave., Mamaroneck, N. Y. The general object of the invention is to provide a raising and lowering means of simple construction adapted to wind in and pay out the suspending ropes or cables in the raising and lowering of a scaffold, the special object being to insure safety and positively and automatically preventing the accidental dropping of the scaffold either at one or both ends.

CLOTHESLINE REEL.—J. MIESSNER, 1333 W. 85th St., Cleveland, Ohio. Among the objects of the invention is to provide a reel which facilitates the putting up, or taking down of a clothes line, in that it allows any desired length of line to be used without danger of dragging the line on the ground. A further object is to provide means which prevent twisting and injurious bending of the line compelling it to wind smoothly, and thereby lengthen the life of the line.

HAIR CURLER.—E. CALKINS, 516 No. 7th St., St. Joseph, Mo. An object of the invention is to provide a covered wire pad with an arrangement of covered wire projecting through the curler and having looped ends which permit the ends to be bent over the hair after the latter is wound on the main portion of the curler and to prevent possibility of entangling the wire in the hair.

TABLE-SLIDE CONSTRUCTION.—E. H. COOK, 109 Main St., Watertown, Wis. An object of the invention is to provide a table-slide construction in which the sliding members have L-grooves so constructed as to provide the maximum amount of supporting surface to the plates connecting the members together. A further object is to provide a device in which the end sliding members are adapted to be raised slightly so as to prevent the sagging of the ends of the table.

BAG.—A. J. FARNSWORTH and E. M. ST. CLARE, 516 Sutter St., San Francisco, Calif. This invention relates to bags that are intended for suspension from supporting devices, and particularly to such bags when made of paper or easily torn material; the purpose is to provide a simple and inexpensive bag that can be suspended in such manner that the weight of its contents will be sustained by a relatively large portion of its periphery.

ACOUSTIC DEVICE.—H. D. BROWN, c/o A. Feinberg, 280 Madison Ave., New York, N. Y. The invention aims to provide a device adapted to be worn upon the person of those whose hearing is defective, for the purpose of transmitting and intensifying sound waves and vibrations to the inner ear in order to alleviate discomforts caused by defective hearing, the sound waves being transmitted to the ear at a point opposite the petromastoid portion of the temporal bone.

ASSOCIATION VANITY BOX.—A. E. ROPE, Hilyer Hall, 102 Remsen St., Brooklyn, N. Y. An object of the invention is to provide a neat and attractive assemblage of containers in which articles and material may be supported which a lady may need, and which will facilitate the use of the contents of the device. A further object is to provide a device in which a plurality of separate containers are rigidly secured in a neat and ornamental assemblage.

BUTTON.—R. L. HUFFMAN, Box 33, Brookfield, Mo. The general object of this invention is the provision of a button of simple construction with means for attaching it to any fabric, the button being provided with a neck which serves to retain the button body spaced from the fabric so that another fabric may be easily attached, the neck of the button having mounted on its inner wall hook-engaging means with which the resilient hooks of an attaching means engage. (See Fig. 9.)

BURIAL APPARATUS.—J. D. JENNINGS, 72 Meeting St., Charleston, S. C. This invention relates particularly to an apparatus designed to receive the earth from a freshly dug grave and hold the same until such time as it is desired to refill the grave, at which time the apparatus functions to deposit said earth in the grave in substantially a unit mass. An object is to provide an apparatus which may be folded into compact form and readily transported, with a minimum of time and labor. (See Fig. 10.)

REFRIGERATOR AND COOLER.—W. M. RAPP, c/o Vapo Corporation, 165 Sutter St., San Francisco, Cal. This inventor has been granted two patents of a similar nature, they relate in general to refrigerators for preserving food stuffs, and have reference more particularly to a so-called iceless refrigerator in which a receptacle is equipped with means for storing food stuff, which is so constructed that with the aid of a liquid evaporation, preferably the evaporation of water, the food may be maintained in a perfect state of preservation. The object is to provide such a receptacle which will be properly ventilated, maintain a cooling and refrigerating medium, and may be produced at a comparatively low cost.

PIVOT BUTTON.—M. WEISS, 148 Beach 74th St., Arverne, N. Y. The object of this invention is to provide a simple and efficient button of the pivot type designed to carry a cloth cover and which may be readily attached to or detached from any fabric. Among the purposes is to provide a button for ornamental purposes which will set close to the fabric to which it is attached.

ROLLER SCREEN.—F. R. KOENIG, c/o W. H. Jackson Co., 2 W. 47th St., New York, N. Y. The primary object of this invention is to provide a screen of the roller type especially adapted for use as a protecting screen for fireplace openings. A further object is to provide a screen which may be adjusted to various positions relative to the opening without sagging and without the aid of a positively locking means.

SINKER.—S. MILLS, c/o Mrs. Anna Aldrich, 139 W. 128th St., New York, N. Y. This invention relates to sinkers for fishlines, and has for a general object to provide a sinker so formed as to result in a better hold on the bottom of the water, so that a sinker of medium weight may be employed. The increased holding action furthermore requires less paying out of the line as compared with an ordinary sinker of equal weight, resulting in less strain on the pole and tackle.

TANK.—J. W. KERLIN, East Millstone, N. J. An object of the invention is to provide a tank in which combustible and explosive material may be stored and at the same time protected against fire. A further object is to provide a tank in which the parts are so formed that one or more walls or sheets of water is provided around the tank for preventing explosions or burning of the contents of the tank.

VANITY CASE.—S. ALBERT, 370 Riverside Drive, New York, N. Y. The invention relates to a container adapted to hold toilet articles. An object is to provide a case which embodies in one article means for holding a plurality of articles in separate relation and in such manner that each of the articles held is readily accessible for use, and at the same time to render the case particularly suitable for carrying about in a small space, as, for instance, a pocket or handbag. (See Fig. 11.)

ELEVATOR INTERLOCKING DEVICE.—J. E. W. FOGAL, c/o Fogal-Williams Safety Devices Co., Quincy, Ill. Among the objects of this invention is to provide a combination latch for elevator doors and interlocking safety device which is simple in construction and in which the electrical points of contact are thoroughly insulated. A further object is to provide a device which may be readily attached to the ordinary type of elevator door.

DOOR-OPENING DEVICE.—J. E. W. FOGAL, 1705 State St., Quincy, Ill. The invention particularly relates to a device for operating folding doors. An object is to provide a device having means for locking the sections of the door in closed position and for preventing relative movement of the door until the locking mechanism has been actuated to release the door. The parts are arranged for movement without binding and with very little friction.

Hardware and Tools

HAIR CLIPPER.—C. NANNINI, Manhattan, Nevada. This invention relates in general to hair clippers as commonly used by barbers, but has reference more particularly to means in the nature of an adjustable attachment to enable the clippers to be used for cutting relatively long hair, as well as medium and short length hair, all over the head, without the necessity of using shears.

KNIFE.—L. B. BATES, c/o ROBERT STOBIE, Waterville, Maine. The invention has particular reference to folding knives. Among the objects is to provide in combination with a folding knife means for positively locking the blade respectively in opened and closed positions, and means for releasing said locking means. A further object is to provide means for effecting an initial opening and movement of the blade. The knife is comparatively simple in construction and operation, and inexpensive to manufacture.

DENTAL TOOL.—G. G. BELL, Ashland, Ky. The invention particularly relates to a tool in which a plurality of teeth are provided, adapted to move in various circular pairs when the tool is rotated, for the removal of the excess plaster from a plaster of paris model, and for the shaping up of the model so that it may properly fit within a flask.

LOCK.—M. ARM, 1412 Wilkins Ave., New York, N. Y. An object of the invention is the provision of means whereby the lock may be operated either by a knob or by a key, and whereby whenever the knob is used to actuate the lock the connection between the bolt and the key-operating means may be removed. A further object resides in the provision of a lock bolt of particular construction whereby a double engagement between the casing on the jamb and the casing on the door is effected.

NAIL PULLER.—J. B. BRADLEY, Box 1230, Miami, Fla. An object of the invention is to provide a simple and effective tool which is adapted to be used by cabinet makers, joiners, carpenters, and others working in wood, to occasion the withdrawal of nails driven into wood. A further object is to provide a tool which facilitates the drawing of deeply driven nails without causing any appreciable injury to the article from which the nail is removed.

VISE.—W. SURY, Pieterlen, Switzerland. One of the principal objects of the invention is to provide a vise which is quick acting in that the jaws may be easily adjusted to their approximate positions without necessity of continuously rotating the main operating screw while at the same time not impairing the effectiveness of the screw when it is brought into action. A further object is to provide a vise which is strong and capable of exerting a very powerful gripping action on the work engaged.

COMBINATION DOORKNOB AND RINGING DEVICE.—E. B. CALDERWOOD, 1520 Franklin St., Oakland, Calif. The particular object of the invention is to provide a ringing device hidden in a doorknob that will sound an alarm when the knob is turned in either direction. The device is constructed in such a manner that its outer appearance does not in any way indicate that a ringing device is connected therewith, and a simple means renders the alarm inoperative when desired.

LOCKING BOLT.—S. W. BAND, 580 Valencia St., San Francisco, Calif. The primary object of the invention is to provide means which may be conveniently used for permanently or temporarily clamping plates or the like. The device is especially adapted for use where it is desirable to clamp two or more plates together preparatory to riveting or otherwise fixing them together.

LAWN-EDGE TRIMMER.—J. LEES, 133 So. West St., Allentown, Pa. One of the foremost objects of the invention is to provide a cutting implement for edging that portion of a lawn at the sides of a cement or other sidewalk, a turf remover and cutting gage being included as elements of the implement. A further object is to provide a tool in which the cutting gage is adjustable so that different widths of turf can be removed as desired.

CASTER.—H. R. KNAACK, 144 N. Lincoln St., Chicago, Ill. An object of the invention is to provide a caster that is applicable to various articles of furniture, trucks, and the like, and has means for holding a ball member so that the latter has a rolling contact with the floor. A further object is to provide a device having means for holding a ball member in operative engagement with a floor and for preventing friction between the movable parts.

Heating and Lighting

GAS HEATER.—C. VAN SANTVOORT, 331 South Ave., Waukegan, Ill. An object of the invention is to provide a gas heater in which the heated air is by-passed through a plurality of radiating pipes before it is expelled into the room. A further object is the provision of a device in which the heated air first flows outwardly from the center, then upwardly along the sides and then out at the rear, the air in the room being drawn by the heated pipes and warmed thereby.

OIL BURNER.—W. K. LEWIS, 1918 House St., Cheyenne, Wyo. An object of this invention is to provide a burner which is adapted to be arranged within furnaces and heating plants originally constructed for the use of coal or the like, as a fuel, whereby hydrocarbon fuel, such as various grades of oils may be used for such furnaces without extensive changes, if any, in the ordinary construction. A further object is to so construct the burner as to direct the flame occasioned by the combustion of the fuel radially diffusing the heat over a maximum area.

STEAMING CABINET.—L. ANGELUS, c/o Circle Pleating Outfit Co., 52 W. 31st St., New York, N. Y. Among the objects of this invention is the provision of means whereby articles placed within the cabinet to be steamed are properly and effectually steamed without becoming wet, and effectually steamed on all sides. A further object resides in the provision of means whereby the articles are kept out of contact with the walls of the cabinet, and the condensation of steam properly absorbed.

Machines and Mechanical Devices

ATTACHMENT FOR GATHERERS ON SEWING MACHINES.—H. A. PULLIAM, Box 72, Frankfort, Ky. This invention relates to a seam ripping attachment to be applied to a sewing machine. The invention coordinates the gatherer and an oscillating blade for severing the stitches, movements being imparted to the blade by a reciprocating member associated with the well-known form of gatherer employed on sewing machines.

POWER-TRANSMISSION MECHANISM.—J. IMPELLIZIERI, 192 Meserole St., Brooklyn, N. Y. The general object of the invention is the provision of a simple and durable power transmission device that may be mounted in conjunction with any machine and adjusted to transmit power along different lines. A further object is the provision of a transmission device, the gears and clutch wheels of which are so mounted that they are held against movement lengthwise of their shafts.

RECORDING DEVICE FOR LIQUID PUMPS.—A. B. SNYDER, Grass Valley, Calif. The invention has particular reference to oil dispensing pumps such as are commonly used in automobile supply stations. The device is intended for use as dispensing means in cooperation with a faucet, and to provide an automatic means of eliminating any errors of the operator in the failure to record the sale made.

ROD ELEVATOR.—C. E. SITZMAN, Lost Hills, Calif. An important object of the invention is to provide a device adapted for use in lifting the rod or tube of an oil well, and means whereby the same may be operatively connected to the upper portion of the sucker rod so that when an upward pull is exerted on the device the sucker rod will be elevated, and means whereby the operator may release the device by a spring without possibility of injury to himself.

CLEANING BRUSH.—E. GEIGER, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, New York, N. Y. An object of this invention is to provide a power-driven brush such as is utilized for cleaning surfaces, and an operating mechanism therefor, which will be adjustable to virtually all planes and which will further be primarily adapted to cooperate with the surface to be cleaned, which surface is disposed at an angle to the mounting of the brush.

HEEL CUTTING MACHINE.—A. SCHOEN, c/o Schmidt, 1237 College Ave., Bronx, N. Y. This inventor has been granted two patents of a similar nature, they relate to shoe machinery for trimming the front of heels, the object being to provide a construction wherein the unfinished heels may be fed into the machine and automatically cut at the proper place, the arrangement being such that the heels are manually placed in the machine and automatically moved to the cutter and the heel fronts cut without any further consideration by the operator, the construction includes a rotatable platform with holders for the heels, and the speed of cutting may be varied. (See Fig. 12.)

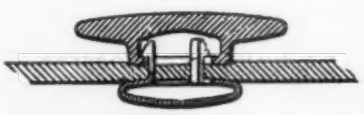


Fig. 9: R. L. Huffman provides a button that comes off less easily and goes on more easily than the conventional sort

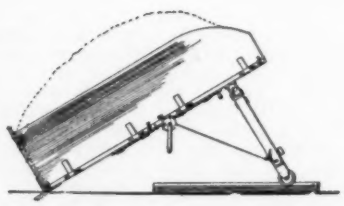


Fig. 10: J. D. Jennings brings the benefits of invention to the grave-digger, simplifying the task of refilling the grave

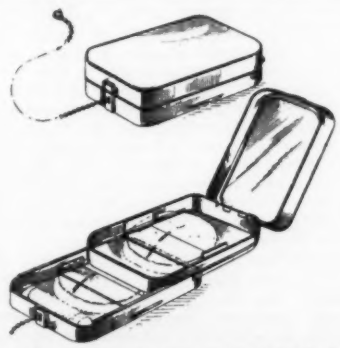


Fig. 11: This vanity case, designed by S. Albert, provides instant access to each of its contained articles

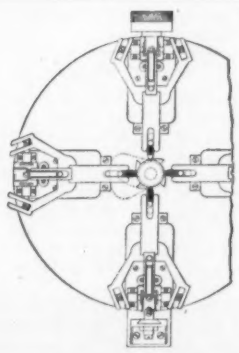


Fig. 12: A. Schoen's improved machinery for trimming the fronts of shoe-heels

CONTROL HEAD.—D. BREEDING, Box 664, Mexia, Texas. The invention relates to well-drilling apparatus, wherein valves are provided which prevent an escapement of oil from the control head while the usual oil sealing device is being applied or removed. A purpose is the provision of a control head in which the valves are supported for movement in arcs of the same circle so that in closed position their confronting edges meet and thus provide a more efficient seal for preventing the passage of oil between the valves and drill cable.

DEVICE FOR STRAIGHTENING PHOTOGRAPHIC PRINTS.—C. H. RISE, Rapid City, S. D. The invention relates to a mechanical device for straightening photographic prints which have become curled during the process of drying. The object is to provide a device which includes an endless belt trained over supporting rollers and a simple means, whereby to cause the same to run true, and means adapted to coact with the belt for delivering the straightened prints therefrom in an orderly manner.

APPARATUS FOR HEAPING OR PILING UP PACKAGES, BAGS, AND THE LIKE.—J. C. THOUVIOT, Paris-L'Hospital, Saone and Loire, France. The invention has for its object to provide a device for taking packages from the ground or from a floor and piling them either on a platform or above the ground. The device is arranged in such manner that the whole of the apparatus may be raised or lowered on wheels, and pushed to required place and the load deposited.

SPLIT HUB HEAD FOR CYLINDERS FOR SPINNING FRAMES, SPOOLERS, AND CYLINDERS OF LIKE NATURE.—W. HERRON and J. H. JESTER, address John P. King Mfg. Co., Augusta, Ga. Among the objects of the invention is to provide a spinning frame cylinder which is constructed in such manner as to permit of the disassembly of the cylinder and the removal or replacement of the shaft upon which the cylinder is mounted with the necessity of removing the cylinder from the cylinder frame obviated.

AUTOMATIC BEARING ADJUSTER.—J. F. ROSE, c/o Kil-Nock Co., Davenport, Iowa. An object of the invention is to provide a device that is adapted to be applied to a bearing and is automatically operated to adjust the parts of the bearing relatively in order to compensate for wear on the bearing and on a member journaled therein. A further object is to provide a device in which the adjustment of the parts is effected by spring actuated means. The device is adapted to be applied to an ordinary bearing without extensive changes.

POULTRY DIPPING MACHINE.—C. E. HEDRICK, c/o Automatic Poultry Dipper Co., Wichita, Kan. An object of the invention is to provide means for removing vermin and scale from the body and legs of fowls, and for automatically dipping the poultry, and thereby relieving the caretaker of the tedious method. The device consists of a runway adapted to be put in communication with the outlet of the poultry house provided with a hinged bottom which will automatically drop the poultry by their own weight into the germicidal fluid.

WARPER SEAT.—A. J. PALIN, c/o A. M. Suprenant, 200 Oak Hall Bldg., Pawtucket, R. I. This invention relates to seats adapted to be attached to a warping machine, to provide a rest for operators. An object is to provide a device adapted to be attached in a desirable position with respect to a control member of the warping machine, or moved out of the way when not in use, and which embodies means operable by the weight of an operator to operate the control member of the machine.

Medical Devices

BED BATHING APPARATUS.—L. E. BERNIER, 1507 Hill St., Seattle, Wash. The object of the invention is to provide an apparatus which may be easily and quickly attached to a bed and arranged for bathing a patient in the bed without greatly disturbing the patient. A further object is to so construct the apparatus that it may be easily folded into a compact bundle and transported from place to place by a nurse or other person.

SUPPORT FOR INVALIDS.—G. KENNEDY, 50 So. Dunlap St., Memphis, Tenn. Among the objects of the invention is to provide a support which may be conveniently associated with hospital beds or any type of bed to provide a convenient support for maintaining the invalid or patient in semi-fallen position. By the use of this device the patient is maintained in proper position although not so restrained as to preclude him from partaking of such movements as are proper and necessary.

SURGICAL INSTRUMENT.—D. LO GIUDICE, c/o George Tiemann & Co., 107 Park Row, New York, N. Y. An object of the invention is the construction of a surgical instrument by means of which the tonsils may be removed from the mouth of a patient without any danger of becoming lodged in the throat, aside from the fact that a severance of the tissue is permitted by means of this device in a more rapid manner, and with less danger of a hemorrhage.

TRUSS.—W. SCHUERG, Menard, Texas. The invention relates particularly to a truss in which provision is made for the alleviation of what are known as scrotal ruptures, the primary object being the provision of a simple, inexpensive form of truss which may be firmly and evenly maintained in proper place with minimum discomfort.

Musical Devices

LEAF-TURNER.—D. HOECKE, 394 Vanderbilt Ave., Brooklyn, N. Y. One of the principal objects of the invention is to provide a mechanical means for successively turning leaves or sheets whereby musicians or the like will be relieved of the necessity of turning the same by hand. A further object is to provide turning mechanism in the form of a clip which may be readily applied to a piano or the like, and a pedal or push buttom actuating means for turning the sheets.

Prime Movers and Their Accessories

CARBURETOR.—A. H. WEBBER, 349 Columbus Ave., Boston, Mass. It is an object of the invention to provide a carburetor which will produce an extremely efficient mixture during idling, and high speed and will additionally produce an efficient accelerating mixture causing the motor to readily take hold during this interval, and virtually precludes any danger of the same stalling, upon its being suddenly subjected to a load, at a relatively low engine speed.

GASEOUS FUEL MIXTURE.—D. BONNELL, 109 W. Hickmann St., Winchester, Ky. The invention particularly relates to a device for mixing the gas fuel elements of internal combustion engines. An object is to provide a device of simple construction which may be placed in the pipe leading from the carburetor to the manifold of the engine, and secured by a mechanism having no movable parts, thus avoiding likelihood of loss or derangement, and avoiding the improper introduction of raw gas into the engine.

VALVE-TAPPET SILENCER.—G. W. MOSEY and C. K. MOSEY, 428 10th Ave., Seattle, Wash. The primary object of the invention is to provide a simple and inexpensive means to relieve the noisy condition caused by the play between the rods and tappets, and further to so construct the silencing means that it may be readily incorporated in the engine structure without necessarily changing the engine to accommodate the same.

ROTARY ENGINE.—S. E. KOCHENDARFER, 407 Tudor Hall, Mass. Ave. and 10th St., Washington, Pa. An object of the invention is to provide a rotary engine embodying means for automatically and gradually cutting off the flow of fluid into the working chamber, with means consisting of the mutually associated and cooperating piston and cam crescent against which it works during a portion of the rotation.

Pertaining to Vehicles

DUMPING BODY FOR VEHICLES.—C. A. HOLT, JR., 2001 30th St., Galveston, Texas. An object of this invention is to provide a side dumping body for automobile trucks and all other vehicles which will enable the carrying and separate dumping of two different materials, or the ready and convenient carrying and simultaneous dumping of the same material. The dumping bodies consist of two lengthwise parallel and sidewise abutting sections, with mechanism for elevating the same from the center of the truck to dumping position.

VEHICLE WHEEL.—A. FREUND, Box 733, Central Station, St. Louis, Mo. This inventor has been granted two patents of a similar nature relating to pneumatic resilient wheels in which the inflated tire structure thereof is isolated from contact with the road in order to minimize wear thereon. The object is to provide a wheel structure which functions precisely in the capacity of the ordinary wheel equipped with a pneumatic tire, but in which a solid rubber tread is presented to the road surface to prevent punctures or stone bruises. Means are provided for connecting the inner and outer fellies by a plurality of telescoping sections secured to the respective fellies.

AUTOMATIC BRAKE FOR MOTOR VEHICLES.—J. PERLIN, 1403 N. Kimball Ave., Chicago, Ill. The invention more particularly relates to a safety brake for automobiles, trucks and the like. An object is to provide a brake which will automatically bring the car to a stop when it strikes an obstacle, and to provide automatic means for placing anti-skid members underneath the rear wheels when the car has struck an obstacle. The device is simple, strong and not likely to get out of order.

TRUCK UNLOADER.—A. W. EGGER, 401 Collins St., Joliet, Ill. An object of the invention is to provide an unloading device having a tiltable body and having means for conveying the load from the truck to a selected place. A further object is to provide a device that can be positioned in desired angular relations with respect to intersecting horizontal and vertical median planes, whereby the load can be deposited at various elevations either directly to the rear of the truck or at either side thereof.

GEARING.—A. SENIW, 70 Richard Ave., Glendale, N. Y. One of the objects of the invention is to provide a gearing in which two shafts may be driven in one direction and more power may be applied to the shafts than is possible in the ordinary form of gearing. A further object is to provide a gearing of this type in which the gears carried by the shafts to be driven are driven upon opposite sides of their respective shafts.

AUTOMOBILE TOP.—S. H. SUMMERSCALES, Box 1891, Winnipeg, Manitoba, Canada. Among the objects is to provide a construction which may be easily manipulated so as to be confined within the walls of the body or extended above the top of the body, and to provide a folding top so constructed that it may be collapsed in such a manner as to be nested without the necessity of taking the same apart.

PERMUTATION LOCK FOR IGNITION SYSTEMS.—F. O. WILLEY, 1815 Southeastern Ave., Indianapolis, Ind. The general object of this invention is to provide a device applicable to the coil box of an automobile for locking the coil elements to prevent surreptitious removal of the coils. An important object is to provide an embodiment of the locking means which will at the same time short-circuit the coil.

TIRE CARRIER.—J. S. KERN, 339 Hillside Ave., Jamaica, N. Y. The invention relates to a carrying frame at the rear of an automobile for supporting a pair of spare tires and their rims. An object is to provide means whereby the tires can be quickly and easily clamped in the frame or removed therefrom, with means for locking the clamping part against movement so as to prevent theft of the tires.

ADJUSTABLE JOINT.—W. H. BOVARD, 1616 Waterloo St., Los Angeles, Calif. The inventor has been granted two patents of a similar nature which have particular reference to a joint to be used for securing the bumper of a motor vehicle to the frame of the same. The frame usually curves downward where it engages the vehicle spring and the curves vary with the different makes of vehicles, the frames also vary in cross section, and it is the object of these inventions to provide a suitable joint between the bracket holding the bumper and the frame member that may be used for practically any motor vehicle and may be easily adjusted so as to maintain the bumper in its proper position.

WHEEL LOCK.—J. B. JOHNS, 905 Dano Ave., E., Warren, Ohio. The aim of this invention is primarily to provide a locking device adapted to be associated with steering wheel such as is utilized with motor vehicles. Another object is to provide a device in the nature of a permutation lock, so that a person authorized to actuate the wheel will not find it necessary to employ a key, the lock being simple yet so constructed that it will be impossible for an unauthorized person to actuate the wheel.

RETAINING DEVICE FOR RECEPTACLE CAPS.—C. A. HAAS, 81 Broadway, Elmhurst, N. Y. An object of the invention is to provide an economically manufactured, simple and efficient means whereby caps of receptacles such as automobile tanks can be retained in close association with the receptacles when they are removed to fill the tank and thereby not very easily lost. The device comprises a chain connected from the head of the closure cap to a spring retaining member.

EXTENSION LEVER.—W. F. B. PRATT, 337 11th Ave., Paterson, N. J. The object of this invention is to provide a lever extension which may be applied to any suitable type of lever, but which is particularly adapted for use with levers having a hand release, such as the emergency brake lever of the Ford car, and by means of which an operator may retract the lever from its normal position, by means of the extension, and by means of which the release also may be operated through the extension.

AUTOMOBILE TIRE RACK.—C. F. HULL, Hagerstown, Md. One of the foremost objects of this invention is to provide a comparatively light yet strong rack on which automobile tires may be hung, for storage or display, by means of hangers especially constructed for the purpose, means being embodied in the rack for simultaneously locking all the hangers in place to prevent the unauthorized removal of any of the tires.

STABILIZING AND ALINING DEVICE.—C. R. LUMLEY, New Castle, Wash. This invention relates to alining devices especially adapted for use with the steering mechanism of motor vehicles. The object is to provide a device of this character which intercepts, absorbs and opposes road shocks and vibrations, eliminates back-lash and causes the vehicle to maintain a true course over rough roads and around sharp curves.

SHOCK ABSORBER.—F. A. DOWLER, 1727 San Antonio Ave., Alameda, Calif. The primary object of the invention is to provide a shock absorber which is adapted to be associated with the spring structure of vehicles such as automobiles for absorbing and diminishing shocks and vibrations incident to the irregularities of the road surface. In this device air is employed as a cushioning medium.

FRONT DRIVE FOR MOTOR VEHICLES.—M. G. MCNEELY, Tulare, Calif. The invention has particular reference to a combination driving and steering device. The principal object is to provide a suitable connection between the front axle of a motor vehicle and the wheels, allowing the latter to be driven by the front axle and at the same time allowing the pivotal motion of the wheels on the axle whereby the motor vehicle may be steered.

VALVE.—W. S. PENFIELD, 141 Beaver St., San Francisco, Calif. The invention relates to a valve which is especially adapted for controlling the discharge of gasoline from the tanks of motor tank trucks such as are used in supplying gasoline service stations. The primary object is to provide a valve which will be quick in action and provide for an expeditious discharge and filling action, which will be leak-proof and easy to operate, and in which damaged or worn parts may be readily renewed.

NON-PNEUMATIC TIRE.—C. A. FISK, 656 Southern Blvd., Bronx, N. Y. The principal object of the invention is to produce a substitute for pneumatic tires, and to provide a filler element for disposal within the outer shoe of a tire which replaces the usual inflated inner tube, functions to give the required resiliency and at the same time eliminates the trouble incident to inflated tires by precluding punctures and blow-outs.

Designs

DESIGN FOR LEATHER OR SIMILAR ARTICLE OF MANUFACTURE.—F. A. KOLB, c/o Geisman, Musline & Brightman, 27 Spruce St., New York, N. Y.

DESIGN FOR A STREET SIGNAL LAMP.—F. MILLIKEN, c/o McNab & Harlan Mfg. Co., John and William Sts., New York, N. Y.

DESIGN FOR A STORE FRONT.—M. WEINGARTEN, c/o London Shoe Co., 110 Duane St., New York, N. Y.

DESIGN FOR A TEXTILE FABRIC.—H. E. GABEL, c/o P. R. Mitchell Co., 5th Ave. and 15th St., New York, N. Y.

DESIGN FOR TEXTILE FABRIC.—C. E. LORD, c/o Galey & Lord, 25 Madison Ave., New York, N. Y.

DESIGN FOR CHILD'S COSTUME.—MARGARET A. YORK, 123 E. 57th St., New York, N. Y.

DESIGN FOR A REFLECTOR.—E. ZIMMERMAN, JR., 73 Anderson Ave., Fairview, N. J.

Study of Material and Methods Needed in Non-Metallic Gear Production

Quiet gear-driven front end obtained. Tests with a typical product indicate blanks are more expensive than metallic type. Fewer tear-downs and easier inspection offset extra cost. Analysis of manufacturing processes improves results.

By J. Edward Schipper

Reprinted from Automotive Industries May 17, 1923.
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A QUIETER front end drive at little or no increase in cost as compared with metallic gears can be obtained by the use of certain non-metallic materials, provided proper precautions are taken in the processes of manufacture. Blanks for non-metallic gears are more expensive than those for metallic, but the difference in the cost of the blanks is offset by a reduction in the number of rejections for noisy operation, and, consequently, of the tear-down and rebuilding operations. However, the material can be used to best advantage only if the manufacturer first acquiresan intimate knowledge of its properties and of the best methods of handling it.

Where gear drive is used for the front end, the problem of silent operation will probably first be attacked by the manufacturer from the standpoint of improving his metallic gears. In analyzing his problem, he will invariably find that the difficulties are, first, the high cost of obtaining extreme accuracy in gear manufacture, and, second, the resonance of the material itself.

The expense of machining metallic gears to extreme accuracy logically leads to a study of non-metallic materials, with which quietness can be secured without going to the extreme in low tolerance limits. Recently there has been considerable discussion of the possibilities of grinding front end gears to obtain accuracy. Owing to the limitations of gear grinding machines up to this time, this, of course, would involve a return to the spur type of gear, a rather drastic step. Developments along this line would be of great interest.

The Formica Insulation Co., manufacturer of non-metallic gear blanks, has made an interesting study of just what can be accomplished with non-metallic material. This concern has more than 200,000 engine timing gears now in service. It maintains that the fundamental requirement made of gear material is that not only must it be able to withstand the stress set up by normal loads, but also to take care of overload and shock stresses.

Metal gears fulfill this requirement, but it is difficult to keep them uniformly quiet, because slight inaccuracies are likely to occur in their manufacture. The metal is not elastic enough to compensate for these inaccuracies when the gear is in operation, and the "ring" of metal striking metal at high speeds forms an undesirable noise. Variations in the clearance between gears caused by whip of a shaft at high speed and by a slight change of centers due to heat expansion accentuate this action.

Non-metallic material should have the requred strength, should be oil and heat resisting, and, in addition, be more elastic and non-resonant. For the same degree of inaccuracy, the non-metallic gear would be quieter, because the vibrations set up by the tooth hammer due to the inaccuracy of the gear form would be of less amplitude.

It must be conceded that someof theearly non-metallic material promised much in experimental work but fell down in service. There has been a great deal of development since that time, with the result that it is now possible to secure products having the required uniformity and endurance.

As the material is non-resonant and is adequate in strength, the entire matter centers about the knowledge of how to manufacture the gears. One manufacturer who has used non-metallic material for years gives the following rules for the production of the gears:

"Take all precautions you would take in cutting a good set of metallic timing gears. Spend plenty of time studying the substance of your non-metallic gear blanks. Learn by experiment its behavior on the gear cutting machine as well as when installed in the timing gear train."

This manufacturer states that attempts to solve the non-metallic gear cutting problem will fail if the utmost pains are not taken. Without a knowledge of the physical characteristics of the blanks, there will be spells of noisy gears and no solution except the very inefficient and costly one of changing timing gears on almost finished engines.

As the opinion of this manufacturer seems to agree with that of most others who have offered their views on this important subject, a further exposition of the points made by him will be of interest. It is necessary to have good machines, in perfect alignment, true running arbors, etc., on which to cut or hob the gears. He advises the cutting of one gear at a time rather than the "ganging" of blanks on an arbor. It is necessary to keep the hobs sharp.

In cutting non-metallic gears, the blanks must be backed up so as to avoid breaking out teeth. As far as speeds and feeds are concerned, most of the non-metallic materials can be handled like brass. Some materials are cut dry. Formica being one of these.

Another manufacturer who has found that non-metallic gears are entirely satisfactory as far as wearing qualities and silence are concerned, states that lapping compound of any kind should not be used in running in the cast-iron gear with a master gear. The abrasive in the lapping compound imbeds itself in the gear and very shortly cuts away the teeth of the non-metallic gear. This manufacturer further states that he suspects that this practice has contributed to any lack of success with non-metallic gears.

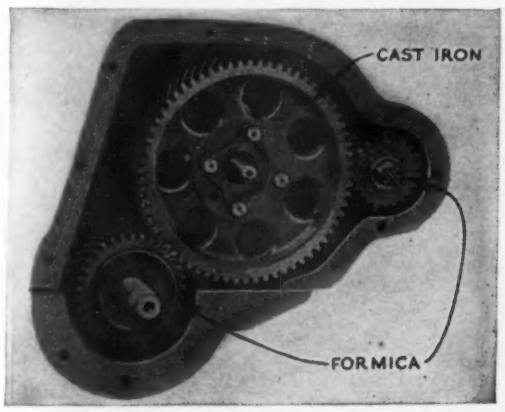
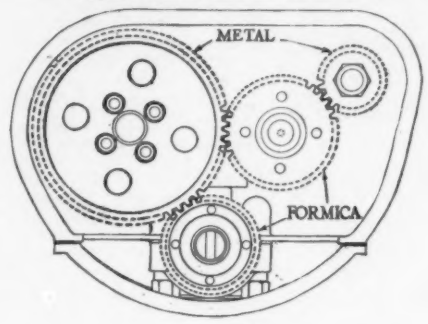


Fig. — A three-gear train with cast-iron camshaft gear and Formica crankshaft and generator gears used on engine for Lexington cars.



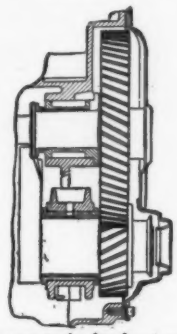


Fig. 2 — Four-gear train for front end drive on Reo engine, employing Formica gears for the crankshaft and idler gears, and metal gears for the camshaft and generator drive gears.

Tolerances for Formica Gears

It is, however, a fact that Formica gears, as used in the front end drive on this particular car in both four and six-cylinder types, have proved satisfactory to the manufacturer. This concern fits the gears with approximately the same backlash as used with metal gears. The timing train on this car has only two gears, the generator and fan assembly being driven from a pulley mounted on the crankshaft extension. The water pump is mounted and driven at the forward end of the camshaft. Noinertia forcesofany magnitudeareimposedonthisfrontenddrive.

Most of the manufacturers using gears of Formica or a similar compound have found that more liberal tolerances for backlash are possible. The shaft centers, however, must be held quite close. One concern cuts the Formica gears to have about 0.003 in. backlash. If the tooth form and helix are held within narrow limits, the results have proved very satisfactory. If not accurate, the gears wear out rapidly, and nearly every case of undue deterioration has been chargeable to improper tooth form or error in the angle of the teeth.

In manufacturing timing gears from non-metallic substances, it is necessary to check the finished product very closely while setting up the tools, as the material has a slight tendency to spring away from the cutter in machining. The Maxwell Motor Corp. has found that the same limits can be held as on metallic gears. When this is done a quiet front end is possible with negligible selection in assembly.

One of the points which is discussed probably more than any other in connection with the use of non-metallic materials for front end drives, is whether the large camshaft gear or the smaller crankshaft and generator gears should be made of composition. For a long time it was believed that the camshaft gear should be non-metallic, but manufacturers of non-metallic gear materials now have become convinced that it is better to make the two smaller gears non-metallic. The reason advanced for this is that the teeth of the crankshaft and generator gears wear only at the point of meshing with the camshaft gear, whereas the camshaft gear wears at two points, where the crankshaft gear meshes with the camshaft gear and where the generator gear meshes with the camshaft gear. Furthermore, there is an uneven wearing action upon the camshaft gear. At one point it is being driven by the crankshaft gear and at another it is driving the generator gear. Hence, the fact that the camshaft gear has twice the number of teeth is more than offset by the double and uneven wear explained above.

Uniformity in Manufacture Stresses

In some cases the composition camshaft gear is at a disadvantage for several reasons. It is quite apparent, for instance, that the strength factors with this type of material decrease very rapidly with increased diameter. Consequently, the smaller gears are far stronger than the larger camshaft gears would be. Furthermore, the cost of the gear blank rises rapidly with increased diameter and, taking account of these various factors, it will be seen that a more durable and lower priced installation results if the two smaller gears are made of non-metallic material, rather than the larger camshaft gear.

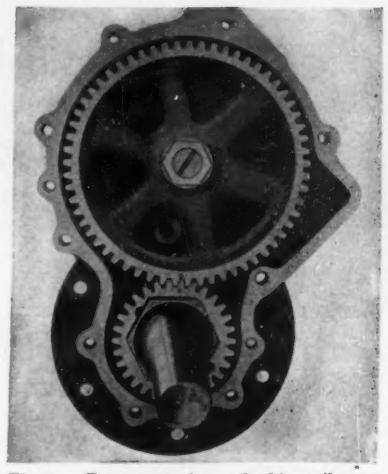


Fig. 1 — Two gear train on the Maxwell motor using a Formica pinion on the crankshaft against a metal camshaft gear.

The development of Formica material has progressed over a number of years, and the method of manufacture is of interest. The big problem is to secure not only the necessary physical properties, but also a high degree of uniformity. Formica is manufactured from a specially woven cotton duck and Redmanol resin, the latter being the anhydrous product of the Bakelite Corp. A feature of the duck employed is that it possessea the same strength in the warp and in the weave, with the result that the finished material has the same tensile strength both with and across the grain.

The cotton duck, in the form of a continuous web, is subjected to an impregnation process comprising two steps and which is claimed to insure the complete impregnation of every fiber of cotton with the resin. After impregnation, the treated duck is passed through a steam-heated oven, the speed of passage, circulation of air and temperature being automatically controlled. The passage through this steam-heated oven starts the reaction in the phenol resin, and drives off all volatile materials, including whatever moisture there may be in the duck itself.

After this treatment, the duck is cut into sheets of the proper size, the individual laminations are built up to the desired thickness and subjected to the final curing process in steam heated hydraulic presses, where a pressure of nearly one ton per square inch is applied. The material is cured at a temperature of about 175 deg. C. The time of curing varies with the thickness of the sheets being manufactured.

The final curing completes the reaction in the phenolic resin and renders the product practically infusible and insoluble in water, oil or any of the ordinary solvents. The material is removed from the presses in the form of sheets, and from these sheets the blanks are cut, either by band sawing or circular cutters. The material is then subjected to critical inspection with regard to hardness, insolubility, tensile strength, moisture absorption, etc.

The final product has a tensile strength of about 10,000 lbs. per sq. in., a modulus of elasticity of 320,000 lbs. per sq. in., a Brinell hardness of 34, a specific gravity of 1.38, and a coefficient of linear expansion of 0.00002 per deg. Fahr.

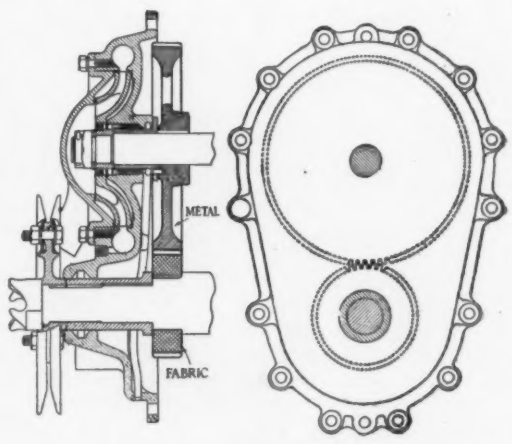


Fig. 3 — Typical fabric gear drive as used on the Oldsmobile.

Formica is made and sold by The Formica Insulation Co., Winton Place, Cincinnati, O.

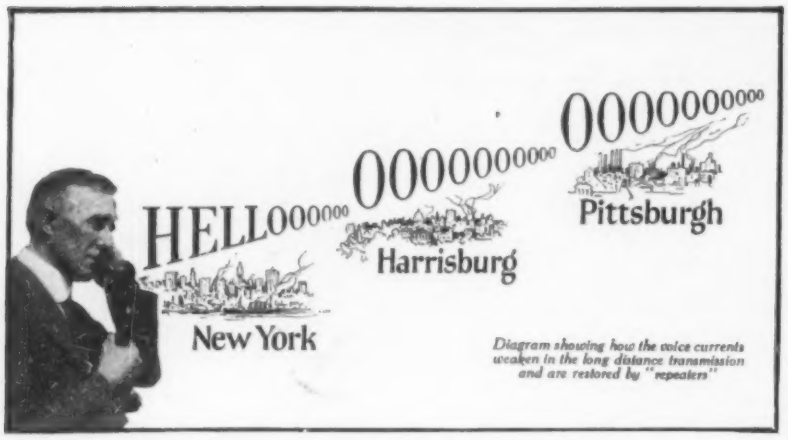


Diagram showing how the voice currents weaken in the long distance transmission and are restored by "repeaters"

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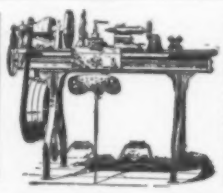

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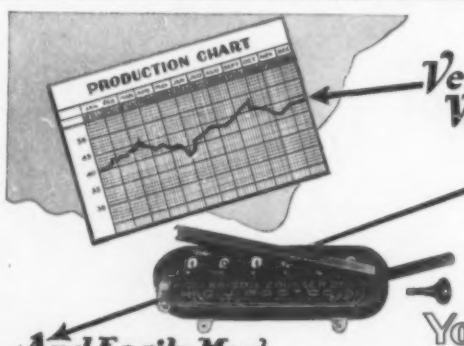

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Miscellaneous Notes

16,500,000 Books Printed.—Basing conclusions on what is considered reliable data, an English librarian estimates that since the invention of printing in Europe in the fifteenth century the output of the world's book presses has amounted to about 16,500,000 titles, of which some 4,400,000 have been printed since 1900. The librarian believes that perhaps 20,000 of all the books printed still possesses value.

No Girl Engineers Need Apply.—An English steamer recently shipped a woman engineer. This was a concession made by the powerful union to enable her to complete 18 months at sea so as to become a fully certified engineer. Work in an engine room especially on a smaller type of steamer is very hard and seems beyond women's strength. It is not likely that the experiment will be repeated, shipping men think.

An Electric Fashion.—To keep up with the fashion a woman must change her handbag pretty often. The latest is an illuminated one. When the bag is opened a tiny electric bulb is immediately switched on, showing the interior, and allowing the owner instantly to find keys, money, theater or railway tickets, or to use the little mirror which is one of the fittings. Thus is woman saved from hunting in her bag in the darkened theater or taxi.

Ocean-Current Investigations.—In connection with its studies of the distribution and movements of larval fishes and other pelagic marine organisms, the Bureau of Fisheries has undertaken investigations of ocean currents of the north Atlantic coast and for that purpose has deposited about 1500 drift bottles. These have been dropped on three lines, running respectively, for a distance about 75 miles off Cape Elizabeth, 150 miles seaward from Chatham, Mass., and 150 miles seaward from Sandy Hook. The stations are at intervals of about one-half mile, two bottles being dropped at each, with drags at different depths, the bottles being weighted so as to float with but a small part of the neck exposed. Each bottle contains a card offering a reward of 25 cents if sent to the Bureau of Fisheries with information concerning the date and location at which it was found. Upwards of 200 of these cards have been received already.

Cheaper Sleeping Cars in France.—Sleeping cars on the continent are something to be indulged in only after counting the cost, but drastic reductions in rate must be made if the traffic is to be restored to normal volume. France is leading the way by introducing second and third class "couchette" cars. The first class rates have been outrageous. With the new cars, one can travel in a second class "couchette" for less than the straight first class fare, and in a third class "couchette" for less than a straight second class fare. The price for 250 kilometers (156 miles) in the second class is 16 francs and 65 centimes, and in the third class 11 francs and 60 centimes, both in addition to the railroad fare. Couchette compartments are constructed with six potential bunks. These comprise seats—the back of the seats raised in a horizontal position—and a new type of hat rack, broad and strong enough to hold a sleeper comfortably. The innovation is a great boon to those in moderate circumstances, as a great amount of long distance traveling is done by the middle class and tourists at night.

A Postal Improvement.—Another time and labor-saving device for use in expediting the mails has passed the experimental stage and is being tested by the Post Office Department. The device will pre-cancel stamps put up in coils for use on other than first class mail by large mailers, before the stamps have been affixed, and will then recoil them in the original sized coil. Heretofore many large users of such mail have purchased uncanceled stamps in coils which were then placed on outgoing mail by stamp-affixing machines already in general use, necessitating the running of such mail through the canceling machines at the post office. With the new device in operation, however, the stamps would be purchased already canceled. The mail with the canceled stamps affixed would then be sorted and tied in bundles by the mailer according to destinations and sent to the post office where it would go to the trains, leaving the canceling machines at the post office free for other work. The new device is called a pre-canceling machine. Various types have been developed by a number of manufacturers to a point which the Department believes warrants giving them a try-out.

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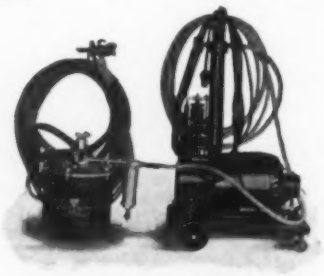

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Science Notes

A Large Telescope for Argentina.—A 60-inch reflector has recently been completed by a Cleveland optical works for the Argentine National Observatory. The mechanical equipment is unusually accurate and the entire instrument is a credit to the optical skill of a great firm of builders of machine tools.

Diminishing Death Rate.—The death rate of 1922 was the lowest of any year excepting one in the history of the United States and Canada, according to the statistics of the Metropolitan Life Insurance Company. The rate was 8.8 persons in each 1000 in 1922, while in 1921 the rate was 8.7 persons.

A "Nutrition" and Intelligence Quotient Slide Rule.—Dr. Thomas D. Wood has designed a new slide rule to simplify the "nutrition" calculations in which deviations from average weights of children are expressed in terms of percentages of such averages. The slide rule has great terrors for the uninitiated, but when once mastered is a great time saver.

An Italian Fresh-Water Laboratory.—Lake Trasimeno, on the road to Rome from Perugia, is of great historical importance, as it was here that Hannibal gained a sanguinary battle in 217 B. C. The lake abounds with fish so that it is admirably adapted for biological researches. The lake is 31 miles in circumference, and the altitude is 850 feet. The new laboratory will be attended by students from several foreign countries.

Another Mean Thief.—Sometime ago we called attention to the mean thief who stole platinum from the terminals of the lightning rods of Notre Dame in Paris and now we have a meaner thief or thieves. Germany's most important earthquake observatory at Koenigsberg was put out of commission when all the bronze parts of the seismograph were stolen. Situated on the Baltic-Russian Plateau, the observatory enjoyed a unique position for earthquake investigations.

Wren's Science Museum.—During the recent Wren celebration interest was focussed on St. Paul's and the beautiful London churches designed by him, but attention should be called to the fact that he designed the Old Ashmolean Museum at Oxford. This was the first public museum of natural history and was only a few yards away from the famous Sheldonian Theater, an earlier work of Wren. The original meetings of the Royal Society, of which Sir Christopher Wren was at one time the president, were also held here.

A Voice with Five Octaves.—At a recent meeting of the Austrian Society of Experimental Phonetics in Vienna, Dr. Réthi presented Michael Prita, age 44 years, whose voice possesses the remarkable range of five complete octaves. The deepest note uttered by this singer was a bass F corresponding to 42 vibrations per second and two octaves lower, therefore, than the deepest note which can be produced on the violin. The only previous record of so low a tone in the human voice is that of a bass singer named Fischer, who lived in the early part of the 18th century. Prita also rendered upper C with its full artistic value. Beyond that the notes passed into the head register and into a falsetto resembling a soprano, says *The English Mechanic*. The highest notes emitted were the upper F (demi-semi-quaver), and on exceptional occasions upper A (demi-semi-quaver), corresponding to 1740 vibrations per second, which is one note higher than the highest sung by Patti.

Windowless Museum.—Dr. F. A. Lucas, Director of the American Museum of Natural History, thinks that the museums of the future may be dependent upon artifical light entirely, at least for certain classes of exhibits. Dr. Lucas describes a series of tests made by Sir Sidney Harmer, Director of the British Museum of Natural History, wherein objects were exposed to different kinds of light continuously for nearly three years. Of these tests Dr. Lucas says: "They show conclusively that electric light is much less harmful than daylight and Sir Sidney writes: 'A gallery without windows, lighted entirely by electricity, preferably not arc lights, would have great advantages.'" The failure to produce a transparent non-actinic glass capable of filtering out the destructive elements from sunlight, says Dr. Lucas, means that museum authorities must turn to electric light for the solution of the problem. It is estimated that the gain in wall space from the omission of windows would offset the cost of electric light. It also would eliminate dark corners in exhibition halls.

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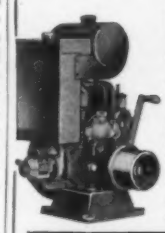

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CUSHMAN

LIGHT WEIGHT ENGINE

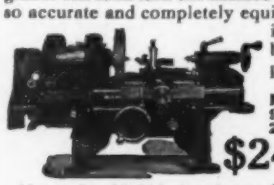
—recognized everywhere as the world's standard light weight highest quality power outfit. Magneto equipped; throttle governed to insure steady running.

Write for catalog of the full line of Cushman Engines, 1 1-2 to 20 h.p. Also Cushman Improved Electric Light and Power Plant.

CUSHMAN MOTOR WORKS 870 N. 21 Street, Lincoln, Neb.

Anyone Can Soon Learn to Operate the MONARCH Jr. Lathe

The MONARCH Jr. 9-inch Engine Lathe is so simple and trouble proof that the beginner can soon turn out finished work—it is so accurate and completely equipped that it is preferred by the expert.



MONARCH Jr 9 inch Lathe 2½ ft. bed—bench legs **$245**

Also made with 11-inch swing at slightly higher price. SEND for CATALOG of MONARCH Lathes which are built up to 30-inch swing.

THE MONARCH MACHINE TOOL CO.
430 Oak Street Sidney, Ohio

GEARS

All Kinds-Small

The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.

Write for Catalogue 20

CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

Ice Making and Refrigerating Machinery

Corliss & Poppet Valve Engines

Bulletins sent upon request

THE VILTER MFG. CO.
899 Clinton Street Milwaukee, Wis.

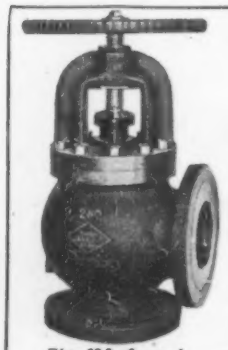


Fig. 293, flanged, Jenkins Extra Heavy Iron Body Automatic Equalizing Stop and Check Valve.

To equalize pressures and as a safety feature

This valve automatically shuts off the flow of steam from header to boiler in case a tube should burst or other internal rupture occur, thereby suddenly reducing the pressure in that boiler.

It also equalizes pressures between different boilers in a battery, preventing one boiler from working at a lower pressure than another.

Send for Descriptive Folder.

JENKINS BROS.

80 White Street ..... New York
524 Atlantic Avenue .... Boston
133 No. Seventh Street, Philadelphia
646 Washington Blvd. ... Chicago

Always marked with the "Diamond"

Jenkins Valves

2720-J SINCE 1864

PARK AVENUE HOTEL

4th Ave., from 32nd to 33rd St., New York
(Subway entrance at door)

One of the best known hotels in the metropolis. Convenient to shopping, theatres, and in the heart of the wholesale district. Less than 50c taxi fare (one or more persons) from either railway terminal. Surface cars pass door.

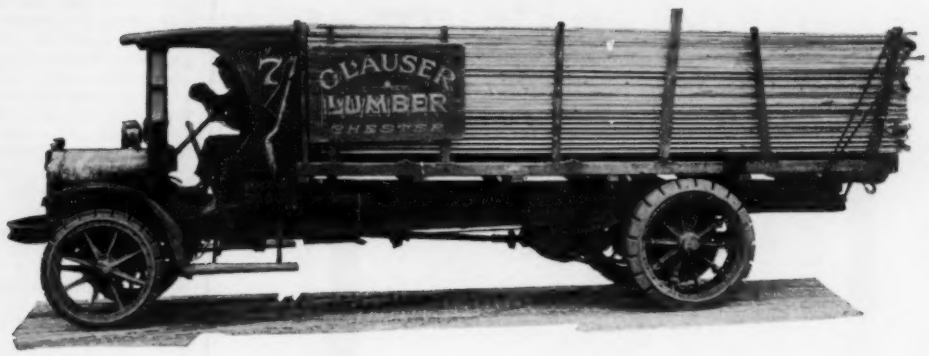
Prices for Rooms

50 single rooms ..... $2.25 per day.
100 single rooms ..... $2.50 per day.
250 double rooms .... $4.00 per day and upward.
Single rooms with bath ..... $4.00 per day and upward.
Double rooms with bath ..... $5.00 per day and upward.

Popular Price Cafeteria and Regular Restaurant

The SUNKEN PALM GARDEN is surrounded by Dining Balconies and a fine orchestra is stationed here every evening.

GEORGE C. BROWN,



—yet their cost is very low

Kelly Kats are massive single-cushion tires especially designed for heavy- and medium-duty trucks.

They have all the sturdiness of solid rubber tires and can stand punishment even better, yet because of their distinctive construction they are able to do many things which solid tires cannot do.

They get traction without chains on almost any kind or condition of road and cushion a truck practically as well as properly inflated pneumatics.

They offer many advantages over pneumatics because they are more dependable, far longer lived and cost a great deal less.

Whether a truck owner buys tires for the service they give or for the money they save, Kelly Kats will satisfy him.

There are no Caterpillar tires but Kelly Kats

KELLY-SPRINGFIELD TIRE COMPANY

250 West 57th Street New York

KELLY KATS

THE TIRES WITH NINE LIVES

And Here are the Reasons

Utica non-shrinking tool steel

SEMINOLE unbreakable chisel steel

SILCROME non-corrosive electrical resistant steel

DELHI HARD a non-corrosive steel for a thousand uses

MOHAWK EXTRA unexcelled high speed steel

PURPLE CUT a better high carbon steel

NEVA-STAIN special non-corrosive steel

Iroquois SPECIAL the edge holding tool steel

POMPTON a carbon tool steel

DELHI TOUGH a rustless easy cutting alloy

LUDLUM SPECIAL STEELS — STEELS SPECIAL PURPOSES

WELLER EQUIPMENT

Wide awake industries are installing equipment to handle their products mechanically—supplanting human labor and reducing operating expenses.

More jobs than men will cut production unless machinery is installed to relieve the situation.

We Make

Conveyors for handling all kinds of materials

Bucket Elevators

Coal and Ash Handling Equipment, etc.

YOU MAY HAVE A MATERIAL HANDLING PROBLEM. SUBMIT IT.

WELLER MFG. CO.

1820-1856 N. Kostner Avenue Chicago, Ill.

Sales Offices:

New York Boston Baltimore Pittsburgh Cleveland Detroit San Francisco

Weller Made Spiral Conveyor Gives the Service

Electrical Notes

Invisible Bell Wiring is a recent British contribution to the electrical field. It consists of two flat copper strips securely held between two paper tapes, which can be easily installed by glue, paste, or cement. The invisible bell wire can be fixed on walls under wall paper, on ceilings under whitewash, or on floors under carpet or linoleum. When run on the surface it can be painted or colored to match its surroundings and is then perfectly invisible.

Loud-Speaker Voice for Operating Room.—An unusual application of loud-speaking equipment is reported in *Radio Electricité*, in connection with the operating room of a French hospital. It appears that above the operating room in question there is a glass roof through which the operations being performed by the surgeon may be followed by medical students. The surgeon, while performing the operation, talks into a microphone in the operating room, and the current is amplified through ten vacuum tubes, for delivery to a battery of loud-speakers in the observation room above. In this manner the medical students not only see what is being done in the operating room, but they receive the explanations from the surgeon at the same time.

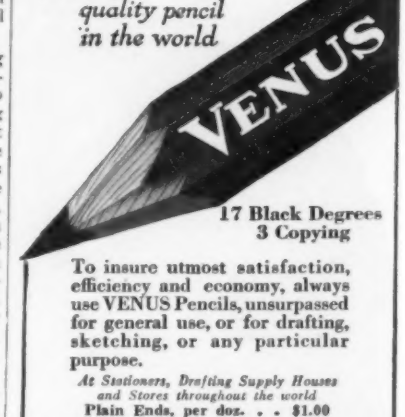
Transmission at 220,000 Volts is now an accomplished fact. According to *Electrical World*, the switches on the Big Creek lines of the Southern California Edison Company were closed and 220,000 volt transmission became an accomplished fact. The event marks the culmination of years of research, experiment and study of the problems of higher voltage transmission by some of the most prominent electrical engineers in the profession. The Big Creek power lines had been operating for some time at 150,000 volts. Before being changed over to 220,000 volt operation additional insulation units were added, making a total of eleven units on suspension and thirteen on dead ends. Each line has a capacity of 125,000 kilowatts at 220,000 volts.

Men Who Made Your Telephone is the title of an attractive advertisement which recently made its appearance in connection with an educational advertising campaign of a leading electrical manufactory. We learn that we are thankful to many races for our present telephone instruments. The British Indian is the swarthy miner of mica—the insulation inside the telephone. The Japanese prepares the silk used in the covering of the telephone cord. The Russian mines the noble metal, platinum, used for contact points. The Egyptian is responsible for certain cottons used in insulation, which originate in the Nile Valley. The Brazilian drains rubber from a tree, and it is this rubber which forms the case of the receiver. The Irishman raises flax, from which is made linen paper, used in the telephone condenser. The Pennsylvanian coil miner contributes the grains of coal used inside the transmitter—the vocal cords of the telephone, in truth. The Alaskan digs such gold as is used in the telephone. Finally, we have the American workman who, from a slab of rubber, a bundle of vegetable and animal fibers and a curious medley of minerals brought from every corner of the world, produces a marvel of precision and ruggedness—your telephone.

Beetles Which Bore Through Lead Cable, but which, nevertheless, do not or cannot penetrate pure gum rubber, have proved a serious problem and pest in California and many other parts of the United States. One of the most important injuries inflicted by these beetles is the damage done to the lead sheathing of telephone cables in California. The beetles bore circular holes in the sheathing, about one-tenth inch in diameter. Moisture enters the cable through these holes, causing a short-circuiting of the wires and interruption of service to the public. As one hole may put from 50 to 600 or more telephones out of use for from one to ten days, the damage is rather extensive. From experiments undertaken by the Bureau of Entomology of the United States Department of Agriculture, it has been learned that the beetle is able to penetrate any lead alloy used as a cable sheathing or any poison or repellant placed on it. Probably it is able to penetrate the poisons because it does not feed as it bores through. Beef tallow, when sufficiently soft, will stick to the beetle and suffocate it, and has been used with some success on the rings which suspend the cable, since practically all the boring is done near the rings. Layers of friction tape impede the boring, and thin sheets of copper, zinc and steel prevent it.

VENUS PENCILS

The largest selling quality pencil in the world



17 Black Degrees
3 Copying

To insure utmost satisfaction, efficiency and economy, always use VENUS Pencils, unsurpassed for general use, or for drafting, sketching, or any particular purpose.

At Stationers, Drafting Supply Houses and Stores throughout the world

Plain Ends, per doz. . . $1.00
Rubber Ends, per doz. . . 1.20

American Lead Pencil Co.
217 Fifth Ave., New York
and London, Eng.

VENUS ERASERS are perfect erasers
Sample on request

Electrical Engineering men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete

In One Year

Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 31st year begins Sep. 25, 1923
BLISS ELECTRICAL SCHOOL
105 Takoma Ave., Washington, D. C.

Park Your Hat for $1

Don't throw your hat on the floor these warm days when you drive without your hat. The SAND'S automobile hat rack protects hats up out of the way in the top—off the floor.

$1.00
Installed In a Minute

Holds and protects either a ladies' or gentleman's hat.

Fastens in the top of any car.

Racine Iron & Wire Works
Specialties Dept. 6, Racine, Wis.

SAVES HATS AND CLEANING BILLS

away from home

the antiseptic germicidal liniment in one container is easiest to carry; dependable for a greater variety of emergencies; safe and pleasant to use and provides against the host's lack of necessary preparations. $1.25 at druggists or postpaid. Liberal trial bottle, postpaid, 10c.

W. F. YOUNG, Inc.
561 Lyman Street
Springfield, Mass.

Absorbine, Jr.
THE ANTISEPTIC LINIMENT

To Users of SAWDUST

HAVING in mind a line of experiments looking to the utilization of Sawdust by preparing same to suit all manufacturers who use that material, we invite correspondence stating what is required in the matter of texture, etc., and indicating prices which the inquirer can afford to pay together with any suggestions which might aid us in our experiments.

Besides being producers of large quantities of Poplar and Basswood Sawdust ourselves, we are located in an important and central wood-working market where our facilities for obtaining and shipping the raw material are unsurpassed.

With reasonable encouragement we purpose to establish a plant equipped to produce Sawdust of any desired texture or kind of lumber specified.

We solicit correspondence and suggestions

STAR WOOD PRODUCTS CO., 24th & Maple, Louisville, Ky.

Why?

The Powers Thermostat Needs no annual adjustments or repairs. Low operating cost, too, means a continuous saving. That's why there's practical economy in installing Powers—even though the first cost is higher.

UP in the freezing altitudes the flyers—in sweaters, in furs, in leather coats and helmets!

Down on the landing field the crowd—sweating and panting with the heat!

Yet the body-heat of the aviators, in spite of external temperature changes, and the body-heat of every healthy member of that crowd, is the same. Why?

Because the human body is provided with perfect *automatic temperature control*—the vaso-motor nervous system. Regardless of weather or climate, man's normal temperature always remains the same.

Powers Automatic Temperature Regulation System is the closest human approach to the perfection of Nature's method. It will render the same reliable, accurate, and unobtrusive service in equalizing the temperature in the buildings you design—ofttimes for a lifetime without a single adjustment or repair.

Let our engineers collaborate in your preliminary plans. Over 30 years' experience at your service.

THE POWERS REGULATOR CO.
Specialists in Automatic Heat Control
2788 Greenview Ave., CHICAGO
NEW YORK BOSTON TORONTO
And 28 Other Offices
Your telephone directory will tell you if our office is in your city
(E2338)

Invention and the "Grifter"

(*Continued from page 79*)

slightest hint of unusual familiarity. And then, turning to the crowd:

"These four ducks belong to the gentleman there. Please remember they are reserved! Not to be played foah! Anything else is yours, my friends! Step right up and win the fresh unkilled poultry!

The Huckery Buck game is gimmicked in a very simple manner. Buried in the earth under the kegs or buckets are a number of stiff wires which lead to taps, plungers or buttons in several parts of the grifter's lair. These control the false bottoms of the various receptacles. If a friend strolls by the grifter neglects to touch or step on any of these controls and the spring bottom does not rise. Naturally, the friend wins. But let the sucker come by with his money and instantly the grifter steps on a control and there is no winning. The ball hits the springed bottom and out it pops.

Whoever has attended a street fair remembers the various prize wheels or "spindles" as they are called by the park and carnival trade. They are all, in some sense, imitations of the roulette wheel. In the good old days they were spun for money prizes. Today they usually "roll" for dolls or candy or blankets or near-Chinese vases.

I regret to say that the vast majority of these wheels are gouged (the grifter term for fixed, when applied to a wheel) in various and clever ways. Some are magnetically or electrically controlled. At the moment when the number winning the valuable prize has just passed the needle, the grifter leans against his table, thus connecting a switch and causing the wheel to dwindle to a stop before it can circle back to the winning number. Others are mechanically stopped at the wrong place, by use of a brake either upon the rim of the wheel or upon the axle of the spindle.

Before I go too far along this line, however, let me record an encouraging fact. The games played in summer parks and along boardwalks are gradually verging toward commercial honesty. Perhaps 50 per cent of all games now permitted are what the grifter calls "percentage rackets." By that he means that the operator of the booth gets a high price or "percentage" but does no fixing or gimmicking.

For instance, in every park and on every boardwalk today are various race horse, balloon inflating, automobile racing and similar mechanisms. Upon a mechanical board are the balloons, horses or motors; before the player is a circular disk which he rotates. This turned wheel controls the movements of a certain balloon, horse or car. There are usually from ten to twenty such mechanical controls for players. Each player pays ten or fifteen cents. Thus a ten-wheel game, at fifteen cents a place, was operated all last summer, in a resort where I was stopping, for prizes of fancy basketware. Every time the grifter started his mechanism he took in a dollar and a half and gave out an ornate basket whose wholesale price was and is less than fifty cents.

But, remember, it's summer; the crowd is sunstruck or moonmad. The pleasure of gambling for something is worth all the difference in value. And there is a peculiar public psychology about the whole thing. A woman friend had her heart set on a rather fine looking piece of Japanese monochrome china in a booth at Atlantic City last winter. She went day after day and played the rollball game of which it was the highest prize. On a Saturday evening she came by, after she had been playing for months and keeping her score in the oriental grifter's book, played a few extra games and finally accumulated enough points to take home the prize. How much did it cost her?

"Well, I just rolled six times tonight," she said exuberantly, "sixty cents!"

By consulting with the friendly Japanese and his score book, I found the vase had actually cost her seventy-three dollars. Its retail value was not more than ten.

But though these percentage games grow in favor, the old tricks survive and the public seems to give them unwavering affection. There is the strength-testing sledge machine. You strike a plunger and shoot a weight up a wire line to ring a gong at the top of a tall beam. The number of pounds of supposed pressure are registered on the sides of the upright column. All day long some lusty looking shillaber stands there and sends the weight to the top at every blow of his mallet. But when you step up—ah the difference! The grifter has simply touched a little control which warps the track-wire

(*Continued on page 142*)

Snow-storms often cost as much as big fires

1. *A Barber-Greene Snow Loader at work in Milwaukee. The number of shovel men replaced varies from 60 to 80, depending on conditions.*
2. *Mayor Hylan operating a Barber-Greene Snow Loader in New York. In Albany, Schenectady and other large cities there are similar loaders.*

3. *In Albany, a Barber-Greene made a record of loading 45 trucks in an hour — greatly reducing haulage time and costs as well as shoveling expense.*
4. *A Barber-Greene in Boston handling 'snow' that is mostly ice.*
5. *A Barber-Greene Bucket Loader handling road-building materials in Illinois. The Snow Loader can be converted into a Bucket Loader and used for handling gravel, crushed stone, cinders and similar material.*

THE Fifth Avenue Chamber of Commerce estimates that a certain heavy snow-storm cost the merchants of New York $60,000,000 loss to business alone. When to this is added the loss to transportation companies, the cost of removal, and the heavy loss in factory and other production because employees come late or not at all, the total becomes impressive even in small cities. The same amount of fire loss caused by inadequate fire fighting methods would cause indignant and effective protests; but snow losses are still considered unavoidable by many. Numerous cities, however, have found that fighting snow is very much like fighting fire — it should begin with the snowfall and not wait until the storm is over. Second, it should have proper equipment. It should not depend on the shovel any more than fire-fighting should depend on the bucket line. In order to devise economical but effective methods and forces before the battle, and to provide the proper equipment before it is needed rather than wait for it after the damage is done, aggressive municipalities, street railways and chambers of commerce begin their planning and educational work in August. A Barber-Greene snow-fighting engineer is always available to present the methods and plans of those who have made progress in the fight against snow. Send for additional data.

BARBER-GREENE COMPANY, *Representatives in 33 Cities* **Western Park Ave., Aurora, Ill.**

BARBER GREENE
Portable Belt Conveyors Self Feeding Bucket Loaders

The New Separator —An Improvement

AFTER two years of testing and proving to make assurance doubly sure, the Gurney bearing comes out with a new separator.

This improvement is the culmination of twenty years' study and experience in the design, manufacture and use of ball bearings.

"Separators Old and New" is a brief, interesting circular you should read; write for it.

Gurney Ball Bearing Co.

Jamestown, N. Y.

GURNEY
BALL BEARINGS

18302

Helping big concerns make iron-free brass—

Just one of the many money-making applications of magnetic separation

IRON in brass and other non-ferrous castings causes a great deal of damage to machine tools. It forms small nodules of great hardness that play havoc when the castings are machined. Brass borings and sweepings invariably contain iron, and yet in the average brass foundry they form twenty per cent of the scrap needed.

Big firms—like the General Electric Co., Lunkenheimer Co., Crane Co., Yale & Towne Mfg. Co.—solve this problem by removing every speck of iron from the borings with Dings "High Intensity" Magnetic Separators.

Magnetic separation has solved countless manufacturing problems. Wherever iron may damage crushing or grinding equipment, wherever materials susceptible to magnetism are to be separated from non-magnetic particles, wherever iron is injurious to the quality of a product—there magnetic separation serves.

The listing opposite gives a realization of magnetic separation's wide range. Ask the engineers of the Dings Magnetic Separator Co., 709 Smith St., Milwaukee, for the bulletins and for instructions for sending samples for magnetic analysis.

Above: Removing iron from brass borings at Whipple & Choate, Bridgeport, Conn.

Where magnetism saves

- in mines, mills and smelters by protecting crushers from damage by tramp iron and by refining and reducing minerals and ores
- in flour mills by preventing dust explosions
- in iron foundries by reclaiming iron from dump piles
- in rubber reclaiming, by removing stray iron
- in glass plants by preventing discoloration and by guarding against crusher breakdown
- in potteries by preventing black specks in china
- in power plants and pulverized fuel plants by protecting crushing equipment
- in cotton seed mills by protecting linters and hullers
- in garbage reclaiming by removing cans
- in the manufacture of drugs, chemicals, sugar, salt, food products, cattle and poultry foods, batteries, carbon, ammunition, chicory, crucible clay, gas mantles, copra, vegetable oil, chocolate and cocoa, paper, pulp, ink, abrasives, glue, brewery products, talc, celluloid, starch, asbestos and in miscellaneous sorting.

See 'phone book for branches in New York, Denver, Richmond, Detroit, Chicago, Pittsburgh, Cleveland, St. Louis, El Paso, Birmingham, Los Angeles, Cincinnati, Salt Lake City, Portland, Ore.

Dings High Intensity **MAGNETIC SEPARATION**

Separate bulletins describe each type

Our Psychic Investigation in Europe—IV

(*Continued from page 86*)

broken, through accidental convulsion on the part of the medium as might easily happen, a claim to this effect could have been advanced at the time or at the end of the seance. In merely putting forward the suggestion that here is the weak spot of this sitting, I am not bound to account in detail for how all the phenomena might have been done fraudulently.

The thread was supposed to remain intact, and importance was attached to its remaining intact, and questionable means were employed of enabling me to judge whether it did so remain, and as a consequence I am unable to assert that it did. This does not by any means damn the seance or its results, but it does constitute a pertinent fact.

Well: with the medium secured as described, the circle was formed, and we were instructed to join hands all around save that the medium's hands were not included. There was thus a break in the circle at the point where the medium sat. I was at the medium's right, and the clergyman at his left; and assuming that no two people sitting side by side were confederates, all hands were accounted for save my left and the Reverend's right. The seating seemed to be quite casual, and I did not feel that there was confederacy. In any event, none of the sitters from the Sunday seance at Crowborough was there save Sir Arthur himself, and the minister; and I really think we shall have to acquit them.

The medium cautioned us not to leap up, cry out, or break the circle of hands under any circumstances; and not to sit with crossed legs. All this, of course, could equally be in the interest of a proper psychic circuit, or with the intent of making the location of all the sitters by a fraudulent operator more certain. The latter explanation was rather discounted when the medium told us that if we thought at any time we heard or felt him moving about the circle, we might lash out and kick about with our feet to our heart's content—just so we did not break hands or sit with legs crossed. He then had me place my left foot upon his right, and vice versa in the case of the clergyman at his other side. His foot could be distinguished from that of any other sitter by his soft felt shoe; my foot remained on his throughout the sitting without withdrawal or substitution, and the clergyman testified to the same effect.

The cabinet was in use. The curtains were drawn at the front; and inside there stood a round-top table, perhaps two feet in diameter, with four legs. On this table were two clusters of sleighbells; a trumpet; and a vase of cut flowers, in water. The minister, by virtue of the lop-sided effect given the circle through tying the medium to one of the cabinet pillars, was squarely in front of the curtains. He was cautioned not to be alarmed when they opened and blew cold winds across him, or when objects were dragged out of the cabinet past him.

The lights went out and the medium went quickly into trance to the singing of hymns, without music. Black Hawk came quickly, speaking in a thin, piping voice, which soon got deeper, displaying then no peculiarity other than unfamiliarity with English. His command of the language was good; only his articulation was weak.

A little vocal work was done here and there during the seance, but only two communications deserve notice. A very recently deceased parishioner of the Reverend came in and asked the Reverend to do something about sending a letter to the decedent's son in Liverpool. The Reverend stated that there were highly evidential details here, and promised to do what was asked of him.

Later, a person calling himself Wallie spoke loudly in my ear, with great confidence, and was highly scandalized when I did not claim him at once. "My God, man, you don't mean to say you don't remember me!" To my best judgment, nobody of the name whom I ever knew is dead; and certainly I never knew a Wallie as intimately as this reproof would assume. He added that he was "Wallie, from the office of the paper"—which was significant in view of the fact that none present save Sir Arthur was supposed to know my professional identity; but even so I wasn't able to identify him, and he left in a huff.

A few other attempts at communication were of no interest; the seance as a whole was of a distinctly physical character.

The first manifestation came from the

(*Continued on page 140*)

50% Saving through Fuel Oil

Bessemer Oil Engines produce power at an average of one-half the cost of steam, and in addition save floor space, upkeep cost and standby time.

This saving of oil over coal is an item too large to overlook. It can even spell the difference between loss and profit.

From experience built up by more than 24,000 successful installations in more than a score of widely-varied industries, covering all types of power-requirements, our engineers will gladly show you just what you can expect of oil-power in your own particular plant.

Write for descriptive catalogue

THE BESSEMER GAS ENGINE CO.
14 York St. Grove City, Pa.

THE BESSEMER GAS ENGINE COMPANY

Pumps!

Deep Well Turbine

Centrifugal

Power Heads

Aurora
Deep Well Turbines Produce
Pure Water

For Pump Advice, write
Aurora Pump & Mfg. Co.
600 Loucks St., Aurora, Ill.

SAMSON HAND PUNCH $3.00

Perforates cardboard, leather and paper up to 1/4".
Thru untempered metal up to 20 gauge.
Extra Punches and Dies for Tool 40c per Size
Handles Interchangeable Punches and Dies as Illustrated.

MACHINE APPLIANCE CORP.
351 Jay Street, Dept. SA, Brooklyn, N. Y.
Sold by all representative hardware and office supply dealers.

Worlds Best Arms

LUGER pistols, barrels 4, 6, 8, 12 and 16 inches; MAUSER pistols, long barrels, holster stocks for both. MAUSER and MANNLICHER SCHOENAUER sporting rifles. Catalog, "C" ten cents.
PACIFIC ARMS CORP. Liberty Bank Building, San Francisco, Cal.

UNISOL
Reg. U. S. Pat. Off.

In Singapore

Straits Settlements, Porto Rico, Canada, throughout the U. S. A.—and on steamships using waters of the various ports of the world—Unisol is being successfully used by those who are interested always to the point of maintaining first-class operating conditions.

If we were not 100% sure that Unisol will correct undesirable boiler feed water conditions, we would not offer it, nor would we forward it throughout the world ON APPROVAL. Pamphlet on request.

UNISOL MFG. CO. -:- Jersey City, N. J.

200 Experienced Young Men Wanted

By million dollar international company, expanding entire organization.

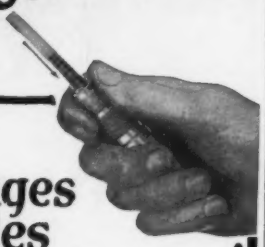
Qualifications:

20 to 35 years of age. College education or equivalent. Must have been in business for two years, preferably for yourself, or as retail clerk, office manager, or engineer.

Write for examination form on which to make your application. Correspondence strictly confidential.

Address Dept. 489 P. O. Box 419
Buffalo, N. Y.

this Screwdriver



changes blades *automatically!*

The picture shows the blade disappearing into the magazine in the handle—and it's as quick as a flash. Tip the handle the other way and the blade you want is produced by gravity.

A turn of the knurled cap at the base of the blade locks and holds it for use. A new tool, strong, compact, well built—three assorted blades in the handle always ready for instant use—you can't lose them.

This SIMORE
AUTOMATIC SCREW DRIVER

$1.80

—yours for $1.80 prepaid, your check accepted. Ideal for auto, radio, shop and household.

Dealers and Agents: Write for our liberal sales proposition on this money maker.

We also make the Simore Universal Try Square. Get acquainted with Simore "Lightning-Change" Tools.

Simon & Skidmore Mfg. Co.
Dept. 11
Santa Ana, California

The Electric VACCU-PUMP

Superior to pumps selling from $200 to $300 each
Will create a 28-inch vacuum

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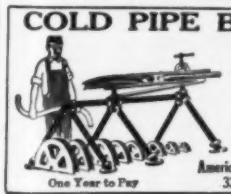

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Mechanical Engineering Notes

Silicon Steel for Bridges.—According to an article in *Iron Age*, silicon steel has entered into the construction of a number of bridges, and is to be an important factor in the new Delaware River Bridge at Philadelphia.

Making Metal Bottle Caps.—The final operations in the manufacture of jar caps, salve and pill boxes, bottle caps and similar articles, such as threading, knurling, beading, curling and trimming are performed by rolling, using an automatic machine.

The Scarcity of Coal since the French invasion of the Ruhr Valley has set the Germans to thinking of ways to use the force of the tides for power. The chief difficulty seems to be that the north coast of Germany is very flat, and consequently that the available head of water is too low for practical use.

Cylindrical Nuts.—A contributor to the *American Machinist* advocates the use of cylindrical nuts. They may be put on and removed with an alligator wrench and are easily made of crop ends of shaftings, and of rods and bars. They may be sawed off, or cut in the lathe with a parting tool and crowned at the same time. When used on machinery they are more easily kept clean than prismatic nuts. Finally, they have a larger footing than hexagon nuts.

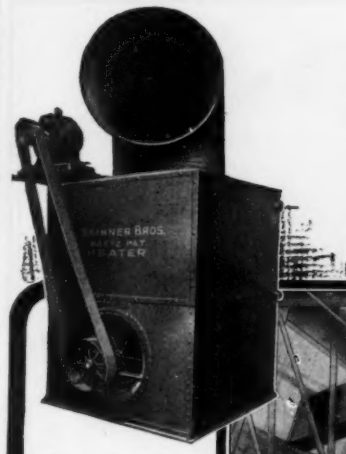
Combined Impulse and Reaction Turbines are smaller and require less material than solely reaction-type turbines, according to *Power*. In the former, steam is expanded from a nozzle and then passed through two rows of revolving blades. The steam from this point is expanded in a long series of reaction blades, where some expansion takes place in each row. The impulse stage has fewer blades and takes up less room than a corresponding staging of the reaction type.

A Metric System Compromise.—The advocates of the metric system, having failed so far to introduce the system into the English-speaking nations, have turned their guns in another direction and are trying to bring about a change in the value of the pound weight, in order to give it simpler relations with the metric system. This would be accomplished by assuming that a pound has a weight of 500 grams, instead of 454. If this could be accomplished without upsetting civilization, the result would be of great value. But the 454-gram pound goes marching on.

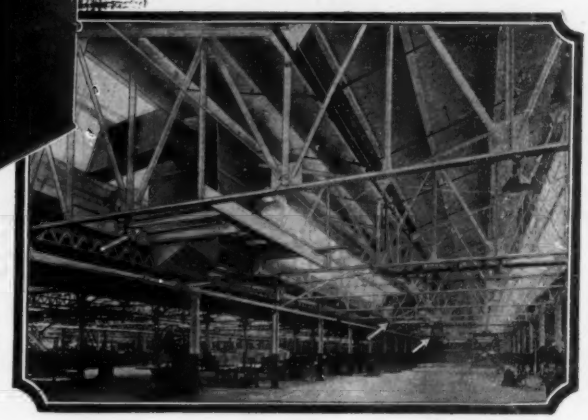
A Radical Departure from ordinary practice has been made on the Detroit, Toledo and Ironton Railroad in that the hand rails of the locomotives, as well as cylindrical heads, steamchest covers and locomotive numbers are nickelplated. The *American Machinist* further describes the changes made, among which are the equipment of all engines with folding repair kits, electric trouble-spotting lights, and a chair for the engineer. It was believed that better care will be taken of the engines if their appearance is made more attractive. The D. T. & I. R. R. is the property of Mr. Henry Ford.

Sectional Dies are used extensively in the production of armature laminations for electric motors and generators, according to *Machinery*, and are also applicable to the manufacture of other classes of stampings containing a large number of perforations. The only essential difference in design between the sectional lamination die and the solid die is that the punch holes in the sectional die are formed by sections arranged radially and accurately fitted and assembled on a plate. These assembled sections form the lower die member; the punches, also assembled on a plate, are aligned with the lower die, as in sub-press construction.

Exhaust Gases from Diesel Engines.—In the opinion of one writer on marine subjects, the most economical way of utilizing the exhaust gases from slow-speed Diesel engines is to lead them through a steam boiler and generate steam to be used in a steam engine, either reciprocating or turbine type, with a condenser. He advocates the use of a reciprocating steam engine rather than a combined Diesel-steam as in the Still engine. He comes to the conclusion that by installing an effective steam boiler with superheater, feed-water heater, etc., utilizing the exhaust heat of the engines and generating steam, connecting this to a turbo-electric set which delivers power to a motor direct-coupled to the main engine, the power can be increased by about 120 horsepower for every 1000 brake horsepower of the main engine.



Steam coil type SC. Uses live or exhaust steam. Where steam is not available, we supply Direct Fired type DF. Burns coal, coke, wood, gas or oil.



General Motors Corporation, St. Louis, Mo., equipped with 16 inverted Skinner Bros. (Baetz Patent) Air Heaters. Note fresh air inlets, dampered for re-circulation.

Industrial heating has actually been revolutionized by the Skinner Bros. (Baetz Patent) Heater—it is the original heater of its type and uses no outside pipes or ducts as warm air carriers. It distributes warmed air evenly throughout every portion of the open area of a building and also acts as a ventilator and air conditioner, either in Summer or Winter.

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DON'T *worry* about heat next Winter—*think* about it now and you will do as hundreds of others have done before. Install Skinner Bros. (Baetz Patent) Heaters and forget your heating troubles.
The Skinner Bros. (Baetz Patent) system is entirely different than old time heating methods and when you install it you can be definitely certain of these things:—

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The receiving set you now have can be readily adjusted to use this new tube and be a source of use and pleasure on your vacation trip. In any event your dealer can give you useful suggestions for the purchase or construction of a highly efficient and practical portable set.

A Specially Designed Tube For Every Radio Use

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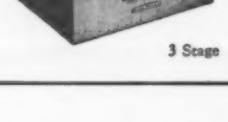

3 Stage

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Radio Notes

Loop Antenna for Receiving.—One of the good effects of the new broadcasting movement has been to bring to attention the great interference problems which exist. The loop antenna has been brought into great prominence for receiving purposes, as a means available for avoiding interference. Practically unlimited receiving ranges are possible with the loop when sufficient radio frequency amplification is used. One reads frequently in the various radio periodicals of the great distances obtained on loops even as small as two feet in diameter. In solving the Naval problems, it is more than probable that the loop can be of service other than its present narrow use for direction finding. It is even conceivable, state Naval authorities, that all receiving may be done on loops sometime in the near future. Some of the advantages claimed for the loop are: (a) Sharp tuning. (b) Wide range of frequencies available in a single coil. (c) One tuning adjustment. (d) Directive effect. (e) Easy portability and replacement. (f) Small space occupied and (g) Very much less reradiative effect when regeneration is used.

Improved Loop Aerial System.—A receiving tube, when directly connected across the tuning condenser of a loop aerial has a voltage impressed on it in two ways: (1) The coil circuit is in tune with the incoming wave, and (2) the coil acts as a capacity area, one end being at or nearer earth potential, since the filament battery is connected to one end of the coil and the small grid to the other, thus giving through the battery a relatively large capacity to earth as compared with the very slight capacity to earth through the small grid, recently wrote F. W. Dunsmore in *Wireless Age*. The voltage induced in the second way is detrimental, as its amplitude is constant regardless of the position of the coil with respect to the approaching wave. To avoid this difficulty an iron-core coupling coil is used. The primary of this is wound in several sections and its ends are connected to the tuning condenser terminals. The secondary is interleaved with the primary and is connected to grid and filament battery. From the latter a connection is made to the rotating vane of a small balancing condenser whose two plates are connected to the tuning condenser terminals. If necessary, the iron core can also be connected to the same filament battery terminal by a switch. It is claimed that this arrangement distributes the capacity effect more evenly to earth and serves partially to by-pass to earth through the iron core disturbing influences such as motor noises.

The "Leviathan's" Radio Set.—Eclipsed only in importance by her powerful machinery and delicate controls, the radio installation aboard the "Leviathan," which reenters the trans-Atlantic service some time in June flying the U. S. Line's flag, will be the most powerful and elaborate steamship radio equipment in the world. The radio equipment of this huge ship will enable her passengers to exchange messages with two continents regardless of her position on the high seas. With equipment six times as powerful as that carried by the average ocean greyhound, uninterrupted communication with points 3000 miles distant is assured. Upon leaving her berth in New York harbor, the "Leviathan's" radio officers will be able to link the ship with various marine centers in Europe, and, vice versa, to communicate with America when leaving European ports. In addition to telegraph service, a radio telephone installation, which will provide voice contact with other vessels and shore stations, is also to be installed. While it is not expected that a commercial telephone service will be inaugurated immediately on the "Leviathan's" going into commission, it is quite probable that shore stations will, in the not distant future, be erected to handle wireless telephone traffic from ships in mid-ocean to points inland over the conventional land-line systems. The principal radio telegraph transmitter to be used consists of a high-power vacuum tube outfit which will deliver to the main aerial about six times as much power as the apparatus now used on the average steamship. The second transmitter is a duplex telephone outfit which will permit simultaneous telephone and continuous wave telegraph communication. The third or emergency sending equipment is a standard spark set which will normally operate on 600 meters. Several super-sensitive vacuum tube receivers will be used for reception.

THE RADIO GUIDE
What to buy and where to buy in order to obtain the best results in Radio communication

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CHARGES "A" & "B" RADIO & AUTO STORAGE BATTERIES at HOME Overnight, for A Few Cents From Any 100 to 130 Volt 60 Cycle A.C. Lamp Socket. F-F CHARGERS made Battery Charging Popular. A-B charges 6 Volt & Up to 130 Volts Of B & Loud Speaker Storage Batteries in Series Inductively At Home Overnight. Disconnecting Batteries & Multiple Connections Unnecessary. Intrusible Rectifying Brushes Maintain Constant Efficiency Uninterruptedly. Complete Portable AUTOMATIC. AMMETER eliminates Guess Work. No Skill Required. Nothing Like It Made. Lasts A Lifetime. Screw Plug In Lamp Socket. Snap Clips on Battery Terminals; Turn Switch & Battery Is Charged In Morning Charged Batteries Mean Fewer Expensive Replacements. It Costs Less To Buy An F-F CHARGER Than To Be Without One. INSIST on The F-F CHARGER. Built By A Master Of The Art In Types Thousands Sold Make Possible These POPULAR PRICES. Type 6 charges 6 Volt Battery At 6 amperes $15. Type 12 charges 12 Volt Battery At 6 amperes $15. Type B charges B batteries Up to 120 Volts $15. Type A-B is Combination of Types 6 & B $20. Type 166 charges 6 Volt Bat. At 12 amps $30. Type 1612 charges 12 Volt Bat. At 7 amps $30. Type 1626 is a Combination of 166 & 1612 & Charges Both 6 & 12 Volt Batteries $50. Types B & A-B are RADIO SPECIALS. Types 166 1612 & 1626 for Large Batteries. SHIPPING WEIGHTS Complete With CHARGES Auto & Radio Batteries AMMETER & CLIPS 11 to 16 lbs. PURCHASE from Dealer. Mail Check, or WRITE for CHARGER C. O. D. ORDER Now, or WRITE Immediately For FREE CHARGER Bulletin 23.

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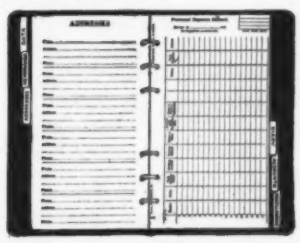

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Radio Notes

Radio in China.—The Peking correspondent of *The Times* of London reports a difficult situation with regard to radio which has arisen in China. Two years ago an American company contracted to erect radio stations in China, and it has now landed engineers and material. The government, however, refuses the necessary consent to the starting of the work, on the ground that other powers have protested that the American agreement conflicts with the rights previously acquired by their nationals. The Japanese are mostly concerned under the Mitsui Agreement of 1918, which gave them a radio monopoly for a period of 30 years. The Americans contend that the monopolistic clause of that agreement is contrary to the theory of the "open door" and incompatible with the terms of the Chinese-American Treaty of 1859. Under the Japanese agreement a large radio station has been for several years under construction near Peking, but it is not yet open for traffic owing to technical difficulties.

History Repeats Itself in Great Britain.—We are not alone in our radio experience. It seems as though Great Britain, which is following in our radio broadcasting footsteps, must pass through much the same experiences as we have passed through. "There are many reasons why this unfortunate controversy should be settled at the earliest possible moment," states *The Electrician* of London, referring to a broadcasting scramble in which the British radio men now find themselves. But more to the point: "And one of the most important of these is that a slump has occurred in the sale of wireless apparatus. This is unfortunate at a time when manufacturers were beginning to get into the swing of the business, but, having all circumstances in view, it can hardly be described as unnatural. The paragraphs, columns, and discussions on the subject of broadcasting which have appeared in the daily press during the past few weeks have, to put it mildly, puzzled the public. Those who were about to buy wireless sets are holding off until they can decide for themselves whether to become a listener-in is or is not an illegal act. Even those who have sets are not certain whether they are entitled to use them, and sales are suffering on that score." True, the British broadcasting situation is unfortunate, especially the licensing phase which compels listeners-in to secure a license from the Government, and pay a rather distasteful fee. But to our mind the British radio industry is passing through the same sort of a slump which struck our young radio industry last summer, at a time when manufacturers were just getting into their full stride and the public, because of summer weather, stopped buying.

A New Pacific Coast Broadcasting Station is to be erected in Oakland, Calif., by the General Electric Company. Work has begun on the buildings, and workmen are already assembling the radio equipment. It is expected that the new station will be in the air within four months. The plans provide for a two-story brick structure. On the first floor will be the office of the studio manager, a general correspondence room for artists and quarters for motor-generator sets and storage batteries. There will be two studios on the second floor, the main studio being large enough to accommodate large bodies of musicians such as a band or symphony orchestra, and a smaller studio from which solo numbers and addresses may be broadcast. The use of two studios will make possible continuous broadcasting. Research is now being carried on to determine the reverberating qualities of the ideal studio in order that the proper amount of dampening may be secured in the Oakland studio to assure the maximum musical quality. The radio control room will be on the second floor. One thousand feet back of the studio building will be the power house and antenna system. The antenna will be multiple-tuned and strung between two steel towers, each 150 feet high and placed 260 feet apart. Beneath the antenna proper will be the counterpoise consisting of a network of wires, 14 feet above the ground, covering an area of 150 by 300 feet. In addition to the power house which will be one story high, there will be a small building for the tuning apparatus and the end of the multiple-tuned antenna. It is probable that an auxiliary studio, connected with the transmitting equipment of the station by telephone lines, will be located in San Francisco.

It happened!

The closed car he has just passed is on fire—the women and children in that car are trying to escape.

If the fire has not gained headway, he can put it out instantly with his Pyrene—save the passengers and save the car.

Whenever you and your family ride in a closed car you face the danger of fire.

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Necessary in every automobile

Pyrene KILLS FIRE SAVES LIFE

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The "New-Way" is not to be compared with any other engine. Besides its superior quality, and its adaptability because of its shape, size and light weight, the "New-Way" operates all kinds of portable and semi portable machines either directly or in connection with a generator, under the most exacting conditions. If you have a power problem let us help you work it out. It incurs no obligation on your part. A letter will bring our traveling engineer to your office. *Write for Circular C23.*

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Our Psychic Investigation in Europe—IV

(*Continued from page 136*)

sleighbells. The table was to one side of the medium and behind him, and, of course, on the other side of the curtain, in the cabinet; I experimented, the next day, and decided that the probabilities were against the medium's being able to get them without disturbing the minister. First they rang from their stand in the cabinet; then they came out and travelled freely about the room, ringing now here and now there, and caressing the faces of the sitters. They journeyed completely about the circle, passed in and out of it at will, went behind it at various points and to various distances, and ranged from floor to ceiling. Soon the second set came into action, and on several occasions the two sets rang simultaneously in widely separated portions of the room. At the end of the seance, one set was found in the lap of my immediate neighbor, the other on the floor at the far side of the circle.

Next on the bill came the flowers. They were taken from their vase and transported about the room. I was first to feel them, and I must say the wet ends, dragging across my face like a handful of cold, clammy fingers, gave me a bit of a jump. While I was trying to make them out, they were presented to my neighbor, blossom end to, and thus identified. They went the rounds, caressing hands and faces and usually lingering over these caresses, and sometimes being specifically presented to the sitter's nose for smelling. At length the bouquet was broken up and blossoms presented to the ladies, in whose possession they were found at the end.

The vase with the water in it next went the rounds, each sitter in turn being gently sprayed with the water—"baptized," Black Hawk facetiously had it. The vase was left on the floor beside one of the sitters.

From time to time during the production of these phenomena the Reverend reported that the curtain was billowing out over him, and once I even felt it where I sat. Always when this happened, the Reverend got the impression of somebody or something passing him into or out of the cabinet. Twice I felt unmistakably the cool wind from the direction of the cabinet. Finally the Reverend announced that the curtains were spread wider than at any time before—and out came the table, high up, clearing the shoulders of the medium and the clergyman. It gyrated back and forth, judging from its contacts with several of the sitters; then settled down a bit. One leg was presented persistently to the Reverend's knee, and finally the table came to earth in the center of the circle, with a thud. It stayed there, and was there when the lights came on; Black Hawk's scorn of collective hallucination being thus vindicated. My best judgment would have been that, with his feet under control as described and the rest of his anatomy entirely free, it would take some explaining to show how the medium could have juggled the table as it was juggled.

The trumpet did a little touching, but nothing to compare with the flowers and the bells. Its big act came with the singing. Without warning, while the circle was rendering one of Black Hawk's favorite hymns, my neighbor and I discovered a deep bass voice between our ears, doing more than its share of the work. It shifted to a point between two other sitters, and while there alternated between alto and soprano. It came back to me as a deep alto—a near-tenor, in fact. It was heard again on the other side as a real tenor. Then it took its stand between me and my neighbor, and for some time sang bass and alto on alternate notes. The control referred to this as a double phenomenon; but, surprising as it was, it was not really that.

At several times I was patted, slammed or pounded on the shoulder with a "materialized hand." At no time did this come to anyone else, which I thought significant; the medium could, of course, have done it to me had his right hand been free. At no time, however, did the arm attached to the hand in question touch the back of my chair where it rose between him and me, though more than once it pounded my left shoulder so enthusiastically that my neighbor felt the blow through my right hand which she held.

Toward the end, all else was abandoned for psychic lights. The control sent his spirit aides into the cabinet to work up the power, and several times he sent them back in disgrace to get built up to better effect. For a while the results were so faint as to be visible only to the person to whom pre-

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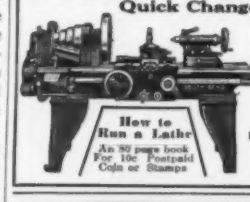

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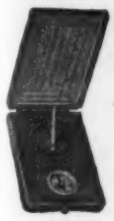

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sented, and his two neighbors. Later they got so that everybody could see the same light. Those presented to me advanced until within a few inches of my face, then withdrew. These ones were apparently balls, but those that passed across the circle as a whole were less defined and could hardly be described as more than luminous patches. A very good range of movement was shown by the later ones, some of which entered the circle (presumably from the cabinet) at the medium's left, to pass completely across and out; while others started within the circle, near the floor, and went upward, apparently, to the ceiling.

Finally Black Hawk bade us good night, we got the lights back, and examined the medium's bonds, as related above. Curiously enough—it happens with Mr. Powell not infrequently, they tell me—the medium did not come out of trance at once, even after we had freed him. He sat there for ten minutes in full light, talking to Sir Arthur and others in the personality of Peter Galloway, a spiritist recently deceased. He talked to the Reverend in what appeared to be Welsh, relapsing into English to say something about bread and cheese. The Reverend, a complete stranger in the circle, explained that there was in his part of the country a hill carrying this curious name, supposedly a corruption of an original Welsh designation. What the original was, however, nobody had ever been able to decide; and it was inferred that an attempt was being made to tell. Mr. Galloway then proceeded to prove his Scotch by giving the approved password, "It's a braw bricht licht, the nicht" (It's a fine bright evening). The statement is made that no Welshman speaking in his own identity could possibly meet this test, but I thought this very reckless indeed; it sounded to me as though any German could meet it, and I could most certainly meet it myself. Aside from the bread and cheese incident, much was said that the hearers accepted as evidential, as impossible of coming from other than Mr. Galloway, as characteristic of his personality, etc.; but it seemed to me that enthusiasm ran off with good judgment in this matter.

Another Forward Step in Electrification

(*Continued from page 92*)

phase converters, which will convert this single-phase to three-phase current for use in the main motors.

The main motors, six in number, will be of the induction type with wound rotors, controlled by liquid rheostats in the secondary circuits. The use of induction motors provides that ruggedness and simplicity of construction and a dependability of operation which characterize this type of motors and does away with the use of commutators.

Power is transmitted through gears and pinions to jackshafts which are connected to the drive wheels by side rods. There are six such motors and six jackshafts per locomotive, each connected to two driving axles. This design enables mounting the motors above the locomotive frame, and the use of side rods makes possible the use of the entire weight on drivers for adhesion, thus making possible a tractive effort far in excess of that possible with individually driven axles.

A feature of the system adopted is its unusual capacity for regenerative braking. It has long been recognized that in such an operation as that of the Virginian one of the most serious problems is that of controlling trains while descending steep grades. This will be accomplished in this case wholly by regenerative braking, the air brakes being held entirely in reserve for emergency use. By virtue of the type of motors and the system adopted, the capacity of the locomotives for holding on down grades will be in excess of their tractive capacity in climbing.

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Carrier Current Telephony

(*Continued from page 100*)

energy for the tube transmitter and receiver.

On the New York street car three 50-watt Radiotrons were used for sending, and an ordinary receiving set with one detector tube and two amplifiers of the UV 201 type for receiving signals. The two transmitters operated on a different wave length and by this means it was possible to carry on a two-way conversation at the same time, just as is possible on the land telephone. Since these wave lengths were greater than 15,000 meters, there was no possibility of any interference with other radio telephone stations.

The successful transmission of voice over electric power lines carrying 70,000 volts by carrier current, a new development of radio, was recently accomplished in Baltimore, Md. Tests were made by engineers over the high tension transmission lines connecting a substation of the Pennsylvania Water and Power Company, Baltimore, with its hydro-electric plant at Holtwood, on the Susquehanna River, a distance of 40 miles. Conversations were carried on under every possible condition that might occur on a power transmission line, such as short circuits, grounding, and broken wires.

For power companies the carrier current system has many advantages over the land telephone, for, so long as there is a single transmission line in operation, communication can be carried on. Ordinary telephone wires, which are many times smaller than the high-power electric lines, are generally the first to suffer during a storm, whereas transmission lines are seldom affected by even the most violent storms.

In the tests made in Baltimore the quality of the speech was much better than that obtained by land telephone over the same route. The conversation was free from hums and other noises which are usually experienced when a telephone line parallels a high-power electric system.

A small switch connected with an ordinary telephone instrument does all the work. By moving this switch upwards, a bell is rung at the other end of the line. The switch then automatically returns to the neutral, or listening position, and the conversation begins. The apparatus is in operation only when a conversation is in progress, the telephone hook holding the receiver acting as a switch for the set.

Instead of radiating the sound waves into space, the high-frequency carrier current is transferred to the transmission line by the condenser action of the capacitive coupler, the energy all being imposed on the electric power lines, and in the magnetic field that surrounds the wires.

Fifty-watt sets are capable of carrying on communications for a distance of 85 miles. Larger sets of 250 watts are being made that will make it possible to extend the distance of communication to 260 miles.

What Makes Glue Stick?

(*Continued from page 102*)

if relatively few large pores are present, as in walnut or Spanish cedar, it is obviously essential to penetrate the small cells, or fibers *F*, as well as the pores, in order to obtain a sufficiently strong anchorage for the glue. The same condition prevails in the conifers, where the cavities of the summerwood (the denser, darker-colored portion of the annual ring) are smaller than those of the springwood, and hence the summerwood is less readily penetrated than the springwood. When considerable areas of summerwood are present on the surfaces to be glued, particular attention to the viscosity of the glue, the temperature of the wood, the pressure applied, etc., needs to be given to secure proper penetration and to insure a good joint. In hard pine and Douglas fir, however, the penetration of the summerwood may not always be necessary, since good penetration of the springwood only may produce a joint as strong as the wood.

Invention and the "Grifter"

(*Continued from page 135*)

slightly, and though you were Hercules and Samson no blow of yours could ever ring the bell. This obtains in cases where the hammer machine is used for prize winning. Where there are no prizes there is likewise no gimmick, and ringing the bell depends solely on a square and honest blow.

Then there are the throwing games. Every American, probably because of youthful baseball or "one old cat," loves to throw. All mankind exhibits some degree of this im-

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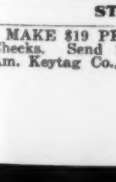

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pulse, based upon the habits of the race in savagery, no doubt, but Americans are especially addicted. So the various games of this sort have a perennial vogue.

Every one knows, of course, that the darky who pokes his head through a canvas and allows the boys, young and old, to try hitting it with a baseball—three shots for a dime—has a steel plate and wig of wool on top of his head with a thick felt batting under it.

Other throwing games are full of similar trickeries. I cannot hope to explain them all in a single article. But take the familiar cat rack. There are some dozen forms of it, but the underlying idea is always the same. Yonder, about thirty feet away, is a cat or a row of cats made of canvas and sawdust. Knock the kitties down with baseballs, according to the rules of each individual grifter, and you win the sub-rosa candies or the Undertaker's Delight cigars. Usually these cats are so weighted at the bottom that even a speedily thrown ball will do no more than move them, unless it hits them at the pivotal point. The grifter tells you where to hit them, in all honesty. But to use the vernacular—try and do it!

Early this year, at one of the parks, I saw a row of these cats on their bench and long familiarity told me they were not loaded. Before the grifter knew what was happening I picked up three balls and, foolishly proud of a good arm, knocked down three of his cats. He immediately and smilingly opened his box of ether perfectos and I declined. Quite according to form, since we were alone, he offered me a bet. I declined it, to be sure, and he set his cats back on the bench. I asked him what the game was.

"Try and knock them off again," he said drily.

I did. Five or six times I hit a cat squarely and with force. The stuffed canvas cats jumped, whirled and danced but they did not fall off the bench.

The grifter led me to the back of his "concession" and showed me a painted steel wire stretched across the back of his cat bench. When he wanted anyone to win he left the wire loose and trailing, but if he desired no winners, he stepped on a plug or leaned against a bar and drew the wire taut. The only way to knock a cat off the bench was to break the wire. I laughed and paid, after I had gone to the front again and satisfied myself that the lights were so arranged that no man could find the wire, even though he knew it was there.

"Knock down the cats, boys! Easy as falling off a log. Just a little speed and control! Merely a game of skill, boys!"

The grifter's cry taunted me down the pavement. To such devices does the inventive spirit of man devote itself—the same spirit that lifted an ape to Parnassus. What can one expect in the good old summer time?

The Reconstructed "Leviathan"

(*Continued from page 109*)

A ship like the "Leviathan" is a floating hotel, and since this is a technical article we can do no more than say that the state rooms, assembly rooms, social hall, restaurant, dining-room, etc., have all been thoroughly redecorated along distinctly American lines. While the best features of the German carving and architectural decorations have been preserved, the color scheme has been changed to the soft tones which characterize the prevailing internal decoration of American homes. The cost of the structural and engineering reconstruction, the refurnishing and decoration of the living accommodations, the supervision, maintenance, etc., brought the total expense, by the time the ship reached New York, up to $8,200,000.

Can the "Leviathan" win the "blue ribbon of the Atlantic," which at present is held by the "Mauretania," with a record of 26.01 knots average for the eastward passage? This summer will tell the story. With her new improvements, she should have no difficulty in surpassing the "Majestic's" record of 24.6 knots average for the crossing, and every effort will be made to equal the long-standing record of the famous old Cunarder, which has stood for 15 years.

Concrete in the Making

(*Continued from page 105*)

not less than 78 per cent of the finished cement must shake through this sieve. Yet the sieve itself will hold water!

Bronze wire cloth that is woven more finely than silk is the screening agency. A silk handkerchief has only 110 threads to the linear inch—silk dress goods seldom more than 187. Yet this metal cloth contains 200 wires each way to the inch, and the

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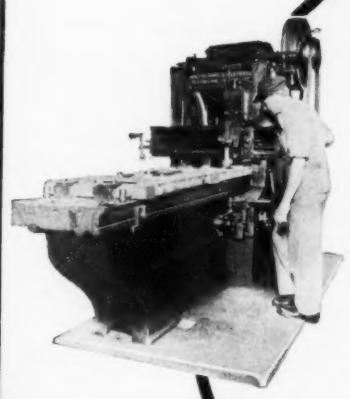

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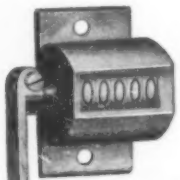

This **small Rotary Ratchet Counter** (No. 6) counts *reciprocating* movements of the lever, as required in recording the operations of many small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adaptable to no end of counting requirements, simply by regulating the throw of the lever. Price $2.00.

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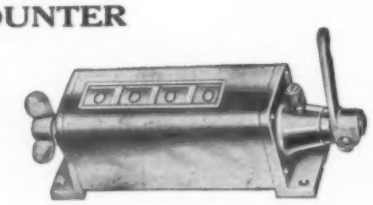

This large **Set-Back Rotary Ratchet Counter** records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation. Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Provided with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50. (List.) Equipped with lock and keys to prevent tampering with the record, $2.00 extra.

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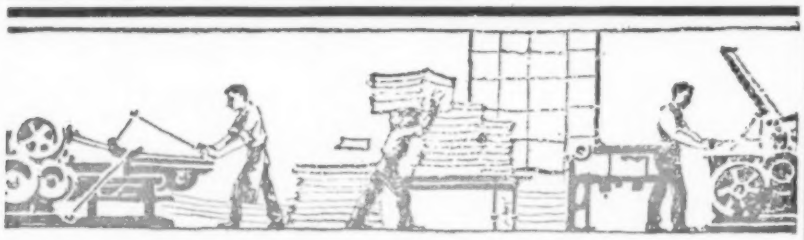

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number in any one inch may vary only within very narrow limits, as the standard specifications for cement govern this point as well as the cement itself.

Into a single square foot of such testing sieve the wire weavers must put a mile of wire. This allows for the extra length required in bending the wires over each other in the weaving. Each square inch of the bronze cloth contains 40,000 holes.

After a sieve is made, it still must be checked before it can be depended upon as sufficiently accurate for cement mill testing. It is either sent direct to the United States Bureau of Standards at Washington, or compared carefully with a sieve that has been so checked. Additional tests of the accuracy of the sieve are made at intervals on samples of known fineness, secured from the Bureau of Standards.

Last year the tonnage of portland cement manufactured in the United States was well over half the tonnage of steel produced, and the weight of the resulting structural material—concrete—was several times as great as that of the steel made. Expressed in units of 376 pounds, the 1922 production was 114,789,984 barrels, according to United States Geological Survey figures.

The volume of construction work in prospect for 1923 is huge, so that demand will doubtless continue heavy during the year. With a potential capacity of some 30,000,000 barrels more than last year's record output, the industry is already equipped to manufacture a substantially increased tonnage if called upon to do so. An average plant today—say one with an annual production of a million barrels—can turn out more cement than was made by the entire industry in 1895. Thus American business expands.

Women on the Farm

(Continued from page 110)

utilization of mechanical power for the field and stable work, a scant 21 per cent of the farm homes which reported in the government survey announced the use of artificial power in the housework. It is a simple matter to harness the gasoline engine so that it will operate various household appliances. Nevertheless, one important agricultural state included in the survey which reported power used on over 50 per cent of the farms also stated that it was used in less than 7 per cent of the houses.

Of the 10,044 farm homes under discussion only 32 per cent were supplied with running water. Sixty-five per cent of these homes have water in the kitchen only, fed from a pump or by a rubber hose connected with a barrel just outside the kitchen. Only 60 per cent of these rural homes have sinks provided with drains and in many cases, the water used, has to be carried from the well outside, a pailful at a time. In 61 per cent of these homes, the water is carried by the women. Of 6784 country housewives interrogated about bathroom facilities in their homes, only 20 per cent replied that their houses were equipped with such conveniences.

The passing of the rural hired girl is strikingly demonstrated by the farm home statistics which the government experts recently have assembled. Of 8700 farm families reporting, less than .1 of 1 per cent reported that they hired woman help throughout the year and only 14 per cent of them stated that they were able to get extra woman help for even short periods during the peak of the harvest, haying and silo-filling periods. From eight to ten per cent of these rural families aim to hire extra woman help an average of 1¼ days a week, for laundry work and cleaning but rarely are able to secure dependable labor of this kind.

Thirty-six per cent of the women interviewed said that they helped with the milking; 56 reported that they cared for the home gardens without any assistance; 81 per cent take care of the farm poultry; 25 per cent help with the live stock and farm chores and 24 per cent assist in the actual field work an average of 6.7 weeks each summer. Furthermore, 35 per cent of these farm women make butter once or twice a week for home use and to sell.

Thirty per cent of these women keep home accounts in addition to the general farm accounts on which they keep tab for their husbands. The records show that 11 per cent of the women selling butter and 16 per cent of those marketing eggs have the resultant money for their personal use. It is of interest that the average of these 10,044 farm homes was 5.9 miles from the nearest high school, 2.9 miles from church and 4.8 miles from the nearest market in addition to being 5½ miles from the family doctor, 12 miles from a trained nurse and 14 miles from a hospital. Despite that 63 per cent of the farms had automobiles and 72 per cent telephones, experience in first aid and elementary nursing are essential if the health of the farm family is to be properly attended to. Illustrative that the country is not as healthy a place to live as some people would have us believe under existent conditions, it is particularly mention-worthy that 20 per cent of the farm families reported one person entirely or partially incapacitated by old age or chronic illness. It is also worthy of note that 7467 typical farm families in different sections of the country report an average for each home of but 1.18 children under ten years of age and .89 between ten and sixteen years of age. As our future agriculture depends on the rural birth rate and subsequent raising of the children, this survey emphasizes the need for better living conditions in the rural home so that child mortality will be curtailed.

What Is Color?

(Continued from page 112)

then the color belongs to the "dull" series. It is evident that only two of the quantities in the equation need be known, for the third can then be found at once.

For instance, the designation 0.60—22—40 denotes a grayish yellow. The fact that it is yellow is derived from the figure 0.6, which refers to the position of the color in the color circle. The figure 22 indicates that the color contains 22 per cent of the pure color tone, while the figure 40 shows that its content of white is 40 per cent. By the use of the equation mentioned above it is possible to find the black content to be 38 per cent.

In determining the composition of any color, it is necessary to have an Ostwald color circle and a means of mixing the colors optically. The purity of the color may be determined by choosing a color tone that resembles the color under examination most closely and by adding to it various amounts of white and black until the color is matched. The light filter may also be used in this analysis. The color tone can be found by the use of an optical mixing device, either a rotating color disk, a polarizing color mixer or a Lambert mixer.

We have spoken only of colors consisting of one color tone. A great many colors, containing more than one color tone, are possible. It has been estimated that there are about four and one-half million colors containing two color tones that could be prepared. About one million more could be made from combinations of three color tones. It is evident that the number of colors is extremely great and the question arises whether so great a number of colors is at all necessary for our needs.

An analogy has been drawn between music and color. In each octave there are twelve tones, but from these twelve tones there can be produced thousands of variations. These twelve tones seem to be absolutely sufficient for all our artistics in the realm of music, which no one will doubt affords one of the finest ways in which the artistic temperament is expressed. There does not seem to be any need for a great number of colors, for after all the intrinsic variation between members of the series becomes rather small as the number of colors increases. It is held that between 500 and 3000 colors would be more than plenty for all purposes. We could still get all desirable variations and novel effects in dress, in interior and exterior decoration, in all the fields of human endeavor where color is of importance, with these colors. Ostwald has proposed the use of 15 dull colors or grays and 2520 bright colors. There does not seem to be any good reason why there should be more.

In conclusion it might be mentioned that the inventor of this new classification of color, Dr. Wilhelm Ostwald, has written prolifically on this subject during the past five years. There are many books printed in German. The advantages of the classification are too evident to require detailed discussion. The number of dyes is increasing each day, and it has been becoming more and more difficult to identify and classify them by their colors. There is always present the demand to match this or that shade, and it is not by any means limited to the case of the unfortunate man who has to match his wife's ribbon sample. The usefulness of the Ostwald classification to paint makers, dyers, textile works and to the host of persons intimately concerned with color is indubitable.

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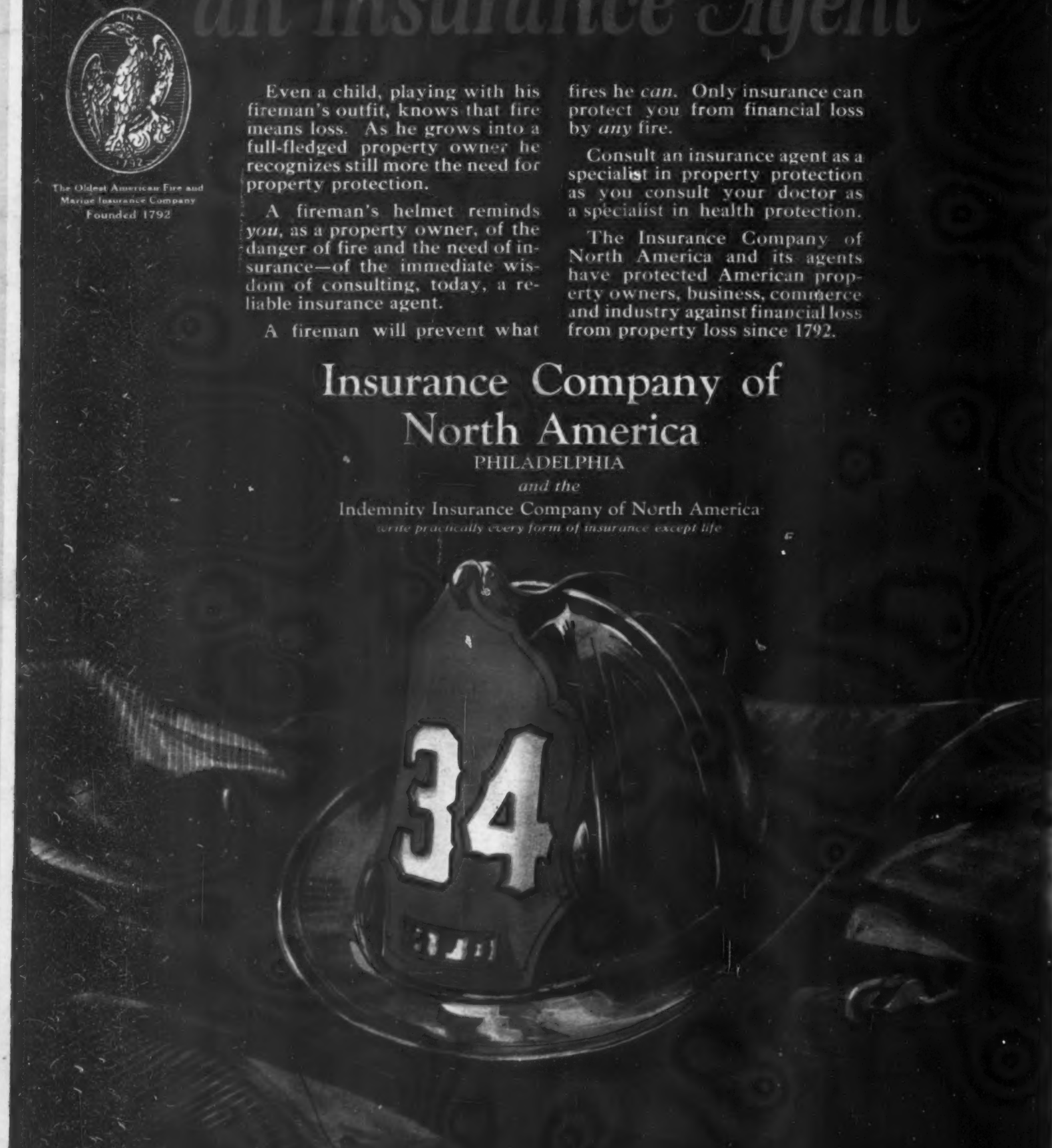
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